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Gas-Fired Reverberatory Furnace at Sulitjelma, Norway

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SYNOPSIS—At Sulitjelma, Norway, the concentrates from the Elmore vacuum oil-flotation process are roasted in an 8-hearth Wedge furnace and smelted in a gas-fired reverberatory furnace having a regenerator for preheating the combustion air. A strongly basic slag is made; magnesite brick and water-cooling pipes are used in the back part of the furnace.

The tailings of the wet concentrator at Sulitjelma, Norway, containing 1% to 1.6% Cu, have been successfully treated for a number of years by the Elmore vacuum oil-flotation process. Over 80% of the copper content of the mill tailings is saved in the Elmore concentrates, which contain 5.8% to 6.8% Cu, the Elmore tailings carrying from 0.13% to 0.25% Cu. The oil consumption is about 2 liters per 1.2 tons of mill tailings. Addition of acid is not made here, as it proved unnecessary. The following are average figures covering six months' operation of the Elmore plant: Wet-concentrator tailings, 1.11% Cu; Elmore tailings, 0.23% Cu; Elmore concentrates, 6.78% Cu. An average analysis of the Elmore concentrates is as follows: Cu, 6.5%; S, 35.3; Fe, 36.8; SiO_2, 12.7; Al_2O_3, 4.83; CaO, trace; MgO, 0.72%. The oil sticks to the concentrates, and this has a marked hindering influence on the further treatment of this material.

SULITJELMA SMELTING PLANT IN NORTHERN NORWAY

Formerly these concentrates were made into briquettes, first with an addition of about 4% of lime, and later with 0.2% of NaCl, added in solution. They were then dried and together with coarse ore were smelted in Knudsen converters. However, the concentrates accumulated and in the autumn of 1911 the Sulitjelma Aktiebolaget decided to build a plant consisting of a Wedge roasting furnace and a reverberatory matting furnace to treat 70 to 90 tons of concentrates daily. As is well known, the coarse ore is smelted at Sulitjelma by the Knudsen process.[1] The melted contents of a converter after a blow are poured into a small gas-fired reverberatory furnace—regenerative system—that serves only as a settler to separate the slag and matte; the slag containing 2.5% Cu is lowered to 0.5% to 0.6% Cu by this treatment. Most of the time, from lack of coarse ore, only one of the 15-ton converters is in operation, and in this case it does not pay to run the gas-fired settler. The contents of the converter are poured on the floor, broken up as soon as cold and smelted once more in a small water-jacketed furnace having a diameter of 1 m. at the tuyeres. The reverberatory furnace of the new plant should serve also as a settler for the molten contents of the converter, thereby eliminating the re-smelting. The new plant was finished during the summer of 1912 and has been in operation since that time.

Oily Concentrates Difficult to Roast

The roasting plant consists of one large modern Wedge roaster with 8 hearths (the drying top hearth included)—a total hearth area of 175 sq.m.—water-cooled shaft and rabble arms. This furnace is so well known that a detailed description is not necessary. It was guaranteed to roast 80 tons of Elmore concentrates containing about 35% S down to 8% S in 24 hr. However, this capacity was never reached. The highest reached, after doubling the number of revolutions, was 60 tons of Elmore concentrates, including 10% of ground quartz,

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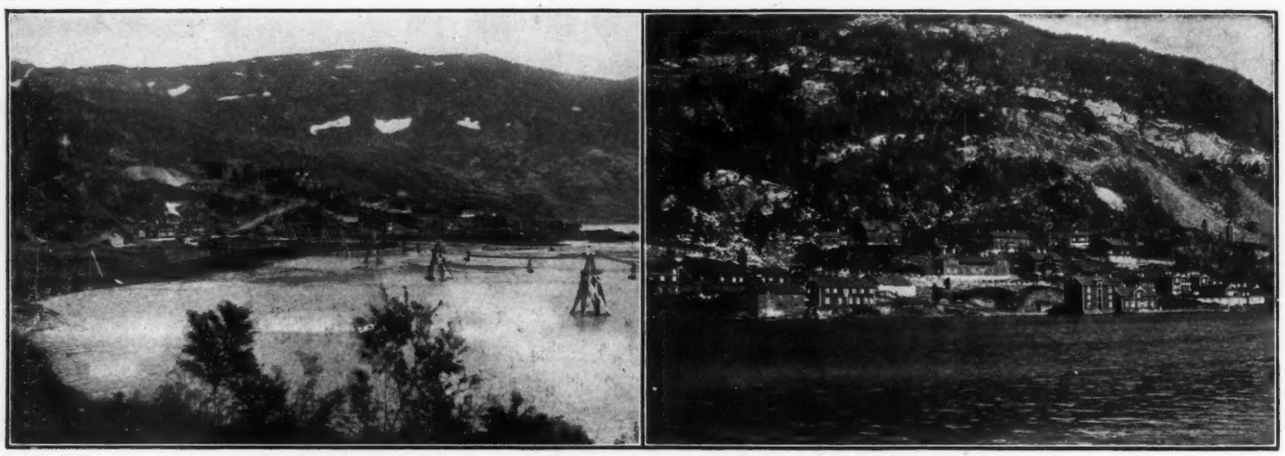
[1]Chem. Ztg., 1909, No. 38; "The Mineral Industry," Vol. XVII, p. 315.

and the average daily treatment during nine months was 47 tons, including 10% of quartz, which was roasted down from 30.72% to 8.12% S. These figures tend to show that Elmore concentrates do not roast easily, and the explanation therefor is the oil film which covers each grain of ore, making it difficult to ignite. It might be mentioned in passing that it is also difficult to sinter this material, probably for the same reason, and pot roasting does not give satisfactory results at all. The Dwight-Lloyd machine showed a smaller capacity than was expected and gave about 15% fines, which had to be recharged.

The wet Elmore concentrates are weighed, then fed into a rotary drier, through which the hot gases of the roasting furnace pass in the opposite direction. The concentrates are discharged into the buckets of an elevator, which delivers them to the upper drying hearth of the Wedge roaster. The calcines drop into two stone bunkers situated under the furnace floor and are discharged through gates into steel cars having a capacity of about ½ ton of roasted material. The cars are taken up by a lift to the level of the reverberatory-furnace charging floor and thence trammed to the charging hoppers.



TWO VIEWS OF SULITJELMA COMPANY'S PROPERTIES IN NORTHERN NORWAY

The view at the right shows the gravity concentrator and the Elmore vacuum oil-flotation plant at Sandtnes. At the left, miscellaneous company buildings at Furuland

The reverberatory furnace was in principle built after the type of the Anaconda furnaces, but recovery of the waste heat of the furnace gases in generating steam was not desired, as the company has very cheap water power (1 hp.-yr. costs at Sulitjelma, interest on the initial cost of the power plant included, 15 kr., about $4.20) and does not have any use for steam. The heat of waste gases is utilized in preheating the combustion air. The new reverberatory furnace is gas-fired, of the regenerative type, with Weardale burners; overall, it is 24 m. long and 6 m. wide. An accompanying drawing shows the reverberatory plant, with gas producers, furnace and regenerator in longitudinal and cross sections and presents the main dimensions of the furnace. The gas producers *A* are of the Schmidt & Desgraz type, with circular nonmovable grate, water-sealed; the diameter of the shaft is 2½ m. They are worked with pressure air from the fan *B* and steam from a small boiler *C*. These producers can gasify 8 to 10 tons of English coal (Hamilton double nut) and give, if not forced, a good hot gas, low in carbonic acid.

The gases of the three producers come together in a main flue *D* and are divided by both gas valves *E* over the roof and back-wall tuyeres. The combustion air comes from a low-pressure ventilator *F* and is divided over the regenerator and the double roof, as shown in the drawing. Part of the air is preheated in the regenerator, passing through vertical tubes of refractory material built in groups of seven and going back through the channel *G* to the back part of the furnace. Another part of the combustion air is preheated in the double walls of the channel connecting the furnace with the regenerator, and also in the double roof of the furnace. By means of two sliding valves *H* it is possible to make a connection between the preheated air in the regenerator and that of the double roof. The combustion gases pass to the front of the furnace, ascend, and then go down through the downtake and the submerged channel *I* to the regenerator. At *J* there are dampers which divide the combustion gases over the proper regenerator and the direct channel *K*. In the regenerator the gases pass on the outside of the tubes. At *L* the combustion gases come together and go to the chimney *M* (artificial-suction arrangement). The producer-gas channels and regenerator are built of "chamotte" brick; those parts of the furnace exposed to high temperatures, for example, side walls and roof, are of silica brick. Silica bricks from Höganäs, Sweden, have given full satisfaction. They are very refractory, do not expand much, are straight and can be cut well. The upper roof is built of third-quality chamotte brick, which do not cost any more than red brick in Sulitjelma. The upper roof is, as will be seen by the drawing, independent of the lower roof, which construction proved satisfactory. The crossbeams in the upper roof bent somewhat from the heat, and in cases of wide furnaces the I-beams should be connected with second ones laid over the top, which will not suffer from the heat, as they would be air-cooled. A larger I-beam would answer the same purpose.

Basic Lining and Water Cooling Employed to Resist Basic Slag in Hottest Part of Furnace

As stated before, the Elmore concentrates contain an average of 12.7% SiO_2. The company does not possess a siliceous material that contains copper, and quartz flux must be brought from a long distance. Therefore

it is necessary to make a slag that is low in silica and high in iron, some slags being as low as 28% and 30% SiO_2. The back and side walls of the furnace up to the fourth door were built of magnesite brick to the level of the bath; as this material does not resist a strongly basic slag at high temperature, the magnesite lining up to the fourth door is water-cooled by a series of pipes, laid in the brickwork.

A detailed drawing shows the cooling pipes assembled, and the general plan of their position in the furnace. The pipes are seamless tubes with an inside diameter of 56 mm., the thickness of the walls being 10 mm. The cast-iron covers consist of two pieces with a planed channel in which the tube fits tightly. They serve to increase the cooling surface, to facilitate the laying of the brick and to protect the tubes. This construction is better and more convenient than iron cast around the pipes, as is generally done.

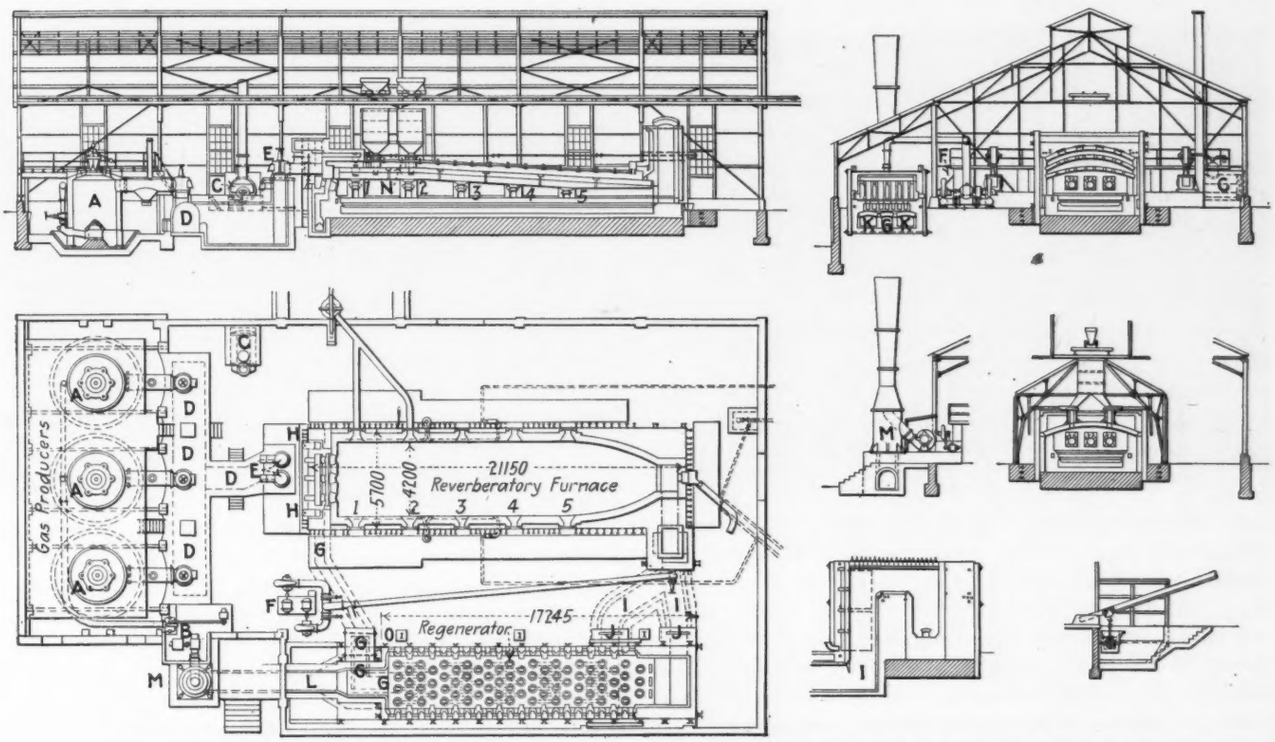
A layer about 300 mm. in thickness, consisting of six parts of ground magnesite brick (5 mm.) and one part of granulated slag, both by volume, is used in the back part of the hearth. This mixture is put in slightly moist and tamped with hot iron tamping bars. This bottom has given satisfaction. The hearth is not attacked by the bath of matte. However, a charge that is being dropped may not spread over the surface of the bath, but sink to the bottom.

The writer therefore recommends that at least the back of the hearth be lined with magnesite, when working with a strongly basic slag. The front of the furnace, the hearth and the side walls, up to the fourth door, may be built of any kind of refractory material, as the slag of a temperature that exists here will hardly attack the brickwork under any normal conditions of operation.

The charging hoppers through the roof of the furnace are iron castings and are lined with magnesite brick. The silica brick near the charging holes are eaten away by the slag formed by dust that strikes the walls when dropping a charge. For this reason it is considered advisable to transfer the charging hoppers to the crown of the arch. The tapholes are under the second and third doors from the back.

The regenerator is of the tube type, with vertical tubes of chamotte; it is so built that it cannot become stopped up, and this was only possible at the expense of its efficiency and dense construction. The regenerator also serves as a dust chamber and is provided with doors on both sides for removal of the flue dust. A dense regenerator with large surface to interchange the heat could not be built in this case, as the narrow passages would soon become clogged with flue dust.

The three gas producers gasify 5 tons of coal each in 24 hr. As previously stated, one producer is able to gasify 8 to 10 tons of English coal. Therefore it is possible to run the furnace with two producers, having one in reserve. However, it is preferred to run them all, as it is easier to make a gas of good quality if not forced too much. Under these conditions the producer gas contains 2% to 4% CO_2, and an average temperature of 500° C. at the furnace valves *E*. The temperature of the preheated air from the regenerator taken at *G* is 500° to 550° C., and that of the air preheated in the double roof at *N* is 420° C. The furnace temperature taken at the first door from the back is about 1,500° C., at the fifth door 1,275° to 1,300° C. and at the skimming door 1,200° C. The combustion gases enter the regenerator with a temperature of 1,000° to 1,100° taken at damper *J* and leave at about 390° C.



REVERBERATORY SMELTING PLANT OF SULITJELMA AKTIEBOLAGET IN NORTHERN NORWAY

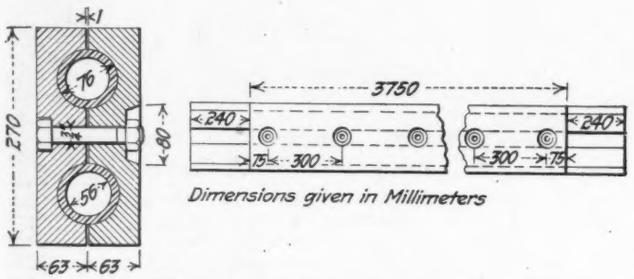
The reverberatory furnace is fired with gas from Schmidt & Desgraz producers and the waste heat of the furnace gases is utilized to preheat the combustion air. The back and side walls of the furnace are lined with magnesite brick up to the level of the bath and are further protected by water cooling

The loss of heat caused by the water cooling of the fire bridge and side walls is about 2,500 Cal. per min., corresponding with about 3% of the coal consumption.

The charging of the furnace is done below with lever arrangement. The chamotte plate which covers the charging hole is pushed back, the sliding valve of the hopper is opened and the hot charge drops into the furnace. Two charges of ½ ton each are alternately charged from two hoppers, and as soon as the 1-ton charge is smelted, the next one follows. Attention may be called to the fact that the roasting furnace does not keep pace with the smelting furnace, and the latter is always waiting for its charge.

Composition of the Sulitjelma Slag

As mentioned before, conditions at Sulitjelma make it necessary to make a slag as basic as possible. The average composition of a normal reverberatory-furnace slag is as follows: SiO_2, 32.5%; FeO, 51.5; Al_2O_3, 10.8; CaO, 1.1; MgO, 2.1; S, 2; Cu, 0.5%. The average SiO_2 and Cu covering a period of nine months was 32.6% SiO_2 and 0.55% Cu, the matte averaging 36.3% Cu. The copper content of the slag goes down occasionally to 0.45% Cu and lower. The high average copper content of the slag, considering the grade of matte,



ARRANGEMENT OF WATER PIPES FOR COOLING REVERBERATORY-FURNACE WALLS

is due to its high specific gravity and also to the fact that sometimes a thick slag with a high formation temperature is made, which tends to keep the matte suspended. The formation of this thick slag is caused by the fluctuating sulphur contents of the charge, which can hardly be avoided if running only one roasting furnace. If the roasted ore contains a small amount of sulphur, the constant amount of silica flux is not sufficient to make a slag of the desired composition. A matte rich in copper and a slag low in silica and high in iron are formed—the so-called thick slag, which forms a third layer between normal slag and matte. The following is an analysis of such a slag: SiO_2 16.1%; FeO, 50.6; Fe_2O_3, 16.2; Al_2O_3, 10.4; CaO, 0.70; S, 1.5; Cu, 4%.

The reverberatory furnace is skimmed once every eight hours. The clay wall built in the slag door is partly cut away, and the slag flows to a cast-iron settling pot through a cast-iron launder bent at an angle of 90° and leading to an opening in the floor. The first straight piece of this launder is provided with a rectangular hole, through which the slag drops into a stream of granulating water from a 6-in. pipe slightly flattened at the end. The granulated slag is then carried to the sea through a launder built of masonry and lined on the bottom with old crusher jaw plates. The hole in the launder lets just as much slag through as can be taken care of by the water, and if for any reason there is an excess of slag that cannot be stopped, it flows through the bent launder to the opening in the floor at the side of the granulating launder. As a safeguard in case of explosions or stopping up of the granulating launder, which runs partly underground, a brick is cut to fit the opening in the slag launder. This can be readily placed or removed as desired.

Frozen Tapholes Opened by Oxygen Method

Matte is tapped as wanted by the converter plant, or if too much accumulates in the furnace it is tapped, through sheet-iron launders lined with brick, into a 2-ton ladle suspended by means of a carriage on a sloping rail; the ladle is pulled to the old converter building and poured at once into a small converter. If by carelessness of the furnacemen the taphole freezes so that a bar cannot be driven, it is not drilled as usual, but opened in the following manner:

An iron tube 3 or 4 m. in length, with an inside diameter of about 10 mm. and walls of 3 mm. thickness, is connected at one end, by means of a rubber pressure tube, to an oxygen flask. The other end is heated to redness by inserting it in the furnace door. The red-hot end is then inserted in the tapping hole, the reduction valve of the oxygen flask opened and oxygen introduced at a pressure of about 6 atmospheres. By the rapid burning of the iron tube in oxygen, there is generated so much heat that the taphole is burned through in a short time. This method is of especial value if a tapping bar has been broken off in the hole, and it is much quicker than drilling—even with a machine drill.

It is an advantage under the present conditions at Sulitjelma to make a matte in the reverberatory of not too high a concentration; for example, about 35% Cu. In doing so less strain is put on the roasting furnace, which is able to handle more concentrates. The grade of the matte is increased from time to time to 40% or 45% by the molten contents of the Knudsen converters (about 50 tons of matte and slag daily), which are dumped into the reverberatory furnace. The matte made in the Knudsen converters contains 50% to 55% Cu and sometimes more—if crusts are formed in the converter and it becomes necessary to run the charge longer than usual in order to melt the crusts down. The converters have a basic or neutral lining, so converting a 35% matte has no disadvantage. The Knudsen converters at Sulitjelma have been basic-lined for over seven years, and the ordinary small converters of 1 and 1½ ton capacity, for several years. However, only the bottoms of the small converters are lined with magnesite brick, the walls being lined with ordinary neutral refractory brick.

The average charge of the roasting furnace during a long period was 47 tons of concentrates, corresponding to 40 tons of calcines. As it is not possible to give the reverberatory furnace all the charge it can handle, it has, of course, a bad effect on the amount of coal used.

With the same amount of coal and a hot charge, it is possible to smelt 70 tons of ore, and in this case the coal consumption would be 23%.

The back and side walls of the hottest part of the furnace need repairing every four weeks. Matte is accumulated in the furnace, and as much of the slag as possible is tapped out. Then almost all of the matte is

also tapped out. The gas is shut off, and the magnesite mixture already mentioned is thrown against the walls of the almost dry furnace. Advantage is taken of this opportunity to burn the soot out of the gas flues. The gas flues must be cleaned every fortnight, and this means loss of smelting time, as the gas must be cut off for about five hours and the furnace loses a great deal of its heat. The gasways in the furnace itself must be cleaned once a week. They can be cleaned one at a time without shutting off the gas.

The flue dust forms a loose deposit on and between the tubes of the regenerator—most of it in the front part near the damper—and must be cleaned out every two or three weeks. No trouble is experienced in taking out the dust from the doors at each side of the regenerator, this being done without interfering with the running of the furnace.

Before closing I should like to make a few general remarks concerning the heating of reverberatory furnaces for smelting concentrates. The chief duty of the reverberatory furnace is to melt down a charge prepared beforehand. It is confirmed by experience that the number of charges that can be made in a certain period of time will rapidly increase with the temperature of the furnace. It follows that such a furnace in which it will be possible to attain the highest temperature will work the most economically. The combustion gases must leave the furnace with temperatures no less than 1,100° to 1,200° C. Up to the present the most efficient way to recover the heat of these gases is in generating steam, and where it is profitable to use steam it is advisable to heat the furnace with semi-gas, oil or coal dust. Semi-gas and oil have been used a long time and are known to work satisfactorily. Coal dust up to the present time is only used in a few places and has been reported a success. It is certainly suitable for reverberatory furnaces, and probably even better than semi-gas. Gas firing can be economical only when there is no use for steam.

In case of gas firing, the ordinary regenerators to preheat the air, built with large surfaces to interchange the heat and of dense construction, cannot be used, as they would soon become stopped up with flue dust. The regenerators must serve also as dust chambers. Regenerative furnaces with large and long chambers without filling material have been used and are reported to have given satisfaction. However, the first cost is considerable, and they occupy a great deal of space.

TAPPING MATTE FROM GAS-FIRED FURNACE

GAS VALVES AT BACK OF SULITJELMA FURNACE

Mexican Mining Taxes

Some of the larger mining operators in Mexico recently transmitted to General Carranza a petition with regard to the excessive taxation that is imposed upon the Mexican mining industry by his recent decrees covering the yearly pertenencia tax and the tax on metal exports. The original English version of this petition, which was translated into Spanish for delivery to General Carranza is as follows:

To His Excellency, Venustiano Carranza
Chief Executive of the Republic of Mexico:

Your petitioners have the honor most respectfully to lay before you the following considerations:

1. Your petitioners represent many of the more important American and foreign-owned mining undertakings in Mexico, both the larger and the smaller. Their interests, however, are identical with the interests of those mining undertakings which are Mexican-owned, and their present plea is in behalf of the mining industry in Mexico as a whole, whether the ownership is native or foreign. They seek no privileges, no exemptions, no preferences. The treatment they hope for, and here petition for, is such treatment only as shall be applicable to all persons or companies alike, who are similarly situated, large and small, Mexican and non-Mexican.

2. The mineral industry in Mexico at the present time is virtually dead. Not more than 3% of the mines are operating. Mines are flooded and caved in. Plants are damaged and destroyed. Machinery and equipment are injured or wrecked. Materials and supplies are exhausted. Operating forces are scattered and demoralized. Necessary means of transportation are either wholly lacking or obtainable with the greatest difficulty and in insufficient amount. This vital need will not adequately be supplied until after the lapse of years. To resurrect the industry will be nearly equivalent to establishing it anew.

3. The investments already made in the mineral industry of Mexico run into many millions of dollars. Again to place the industry on a successful operating and producing basis, these investments must be greatly increased, and very large amounts of additional capital must be expended. Further, all expenses of operation will be enormously increased, particularly in respect to the matter of securing facilities of transportation and of procuring necessary materials and supplies.

4. To the extraordinary costs and disbursements thus involved in a restoration of the industry must be added the very heavy losses, both direct and indirect, which those concerned in the industry have had to bear throughout the

revolutionary period, now in its fifth year. Aside from the wiping out of profits, these losses have resulted from damages to mills, smelteries and surface equipment, caused by revolutionary forces as well as by lawless bands, from the flooding of mines with water through the enforced stoppage of pumping operations because of the lack of fuel and otherwise, from the seizure of animals, supplies, provisions and many other goods, and from the maintenance of unprofitable operations, and the direct importations of food and provisions in order to supply the necessities of life to employes or their families.

5. These burdens are necessary and unavoidable, the hard facts of the situation being as they are; and your petitioners realize that nothing can lighten the load of expense which must inevitably be borne, if they are to save the investments they have already made and if the future, however remote, is to yield them a return. But there is an added burden threatened, which is neither necessary nor unavoidable, nor the inevitable consequence of existing conditions, and which may easily prevent a revival of the industry. This is a burden which it is within your power either to lift or to impose. It is the burden of greatly increased taxes upon an industry already taxed in heavy measure; the burden, in other words, imposed by your Decree of Mar. 1, 1915, as modified by your Decree of Aug. 31, 1915.

6. In asking you to remove this added burden, your petitioners would have you consider not only the relief thereby afforded to private interests, but the public benefits which must accrue to the Mexican people living in the numerous communities which are dependent upon the mining industry for a livelihood or engaged in the many commercial pursuits to which the mining industry gives rise, through the rebuilding of a great industry now prostrate and helpless. Interests of necessity obliged, if they proceed, to expend vast sums of money in a country ravaged by years of civil war, furnishing employment and means of subsistence to thousands of persons to whom no other occupation is open, creating wealth and prosperity to the certain benefit of the state and the body politic, in localities where there is now only poverty and distress, requiring the rehabilitation of the railroads and thus furthering the welfare of the whole people, increasing the imports and exports of the country, and generally promoting the commerce of the land, both domestic and foreign—and doing all this at their own risk and cost and in the face of enormous difficulties—should not, it is respectfully submitted, be discouraged, and not only discouraged, but in many cases dissuaded from remaining in the field, by the imposition of exorbitant taxes.

7. Your petitioners submit and earnestly maintain that the taxes laid upon the mineral industry of Mexico under the Constitutional laws of the Republic, prior to the issuance of your decree above mentioned, are already so high that to raise them would be unjust and harmful to the industry. Such taxes, however, have been fixed by law, and your petitioners accept them as among the necessary charges inevitably to be met. They do not seek to escape them. They are prepared to pay them, as they have paid them heretofore. And they make no protest against paying them in gold. They readily concede that the Mexican government is entitled to receive its lawful due in full, and without deduction by reason of depreciated currency or otherwise. Their protest is directed solely against the multiplication of such taxes, especially at a time when the industry is struggling for its life and before it can be known whether it is to survive or perish.

8. The established pertenencia tax of 6 pesos per pertenencia up to 25, and 3 pesos per pertenencia on all over 25, is an equitable tax, considered in relation to the subject matter; and as one item in a series or group of taxes to which mine-owners are subjected, and since it is to be paid in gold, it should be highly satisfactory to the state as a source of revenue. At the same time it is not unduly burdensome on the taxpayer. At least the taxpayer has adjusted himself to it and is prepared to meet it. Moreover, it is graded in accordance with sound economic policy, inasmuch as the rate is reduced one-half on all pertenencias over the minimum of 25. Under your decree this policy is reversed, and the rate is progressively and rapidly raised as the number of pertenencias increases above the lower minimum of 10. In addition, the tax per pertenencia for those included in the reduced minimum is doubled. To enforce the new taxes decreed would be oppressive and, it is feared, in many cases confiscatory. In the development of mining enterprises along the best lines, the control of large areas is imperative. But the development must proceed gradually. Both the initial and the ensuing costs are great. The larger part of the territory must remain unworked for years, awaiting the growth of the enterprise. But with the first establishment of the enterprise, new industries, new communities and new source of wealth are created. In the meantime the mine owner must carry the pertenencia tax, yearly, on all his claims, developed or undeveloped, productive or nonproductive, operated or not operated. Furthermore, to increase these taxes would be to tax mineral holdings out of all proportion to the taxation on other lands and real estate in Mexico. It would probably discourage small companies and individuals from holding property which might be worked some day when affiairs have been reëstablished on a normal basis in Mexico. Property so released would fail to bring revenue to the Mexican government unless large and wealthy corporations could afford to redenounce them and hold them until normal conditions were again established. The result would be to discourage the companies or individuals with limited resources. It should be remembered, moreover, that the areas held in reserve, on which the tax is nevertheless regularly to be paid, in practically all cases are of low-grade character, unsuited for ordinary development and unworkable except in connection with operations on a large scale, conducted on a systematic plan involving much time and steady outlay.

9. The established export taxes on gold and silver in bullion of 2½% and on gold and silver ores of 3½% are neither light nor easy to bear, but neither are they unreasonable. They are, however, it is confidently believed, as much as the metal industry can stand, in connection with other taxes, with a view to the yield of the maximum revenue to the state from this source. The gross value of metals out of which such taxes must be taken for a long time to come must also be charged with greatly increased cost of production, to say nothing of the added interest on new capital invested. Under your decree the export tax on silver and gold would amount to approximately 6½% when contained in bullion and approximately 8¼% when contained in ores. It is firmly believed that these increased taxes would prove so excessive and so burdensome, particularly on low-grade mines, as to make it inadvisable to attempt operation under them with any hope of profit. It is believed that the new taxes on copper and lead would result in a large curtailment of production, because nearly all of the old high-grade lead-producing mines in Mexico have been exhausted and the present source of lead in Mexico is the low-grade lead mine developed and equipped at a large expense and operated upon a particularly low margin of profit. The character of the copper production in Mexico is much the same as that of the lead. Mexico has but a few copper mines. These are very low-grade and in the aggregate have yielded but a small return of profit to their owners. Clearly, it is to the best interests of the Republic of Mexico, as well as to the mineral industry at large, for the government to encourage and assist the lead and copper producers as much as possible in order to stimulate prospecting and developing of mines of this character. The basis of the entire smelting industry rests upon the lead and copper production of the country. An adequate supply of these two metals insures the development of all classes of mines and thereby brings correspondingly increased revenue to the government. The imposition of such heavy taxes as have been proposed on these two metals will result in the strangulation of a large portion of the mineral industry of Mexico.

10. Finally it is submitted, that if the new and increased taxes here complained of are removed and if some assurance is given that federal, state and municipal taxes on mineral property and mineral production and operation will be allowed to rest on the basis of the laws existing from 1905 to 1910 and if the coöperation of the government can be had in facilitating the importation and reasonable dispatch in transportation and delivery of coal, coke and fuel oil to the various mines and plants, and of dynamite, cyanide and other materials most urgently required by the industry, without additional import taxation, your petitioners and all those in a like situation with reference to Mexican mining operations will be given that encouragement which they sorely need in assuming the heavy undertaking before them of reviving the mineral industry in Mexico; and they confidently predict that such encouragement will result in the earliest possible restoration of the industry in all its branches, with steadily increasing revenue and prestige to the Mexican government; otherwise, they must be greatly discouraged and seriously hindered, if not altogether checked, in going forward with their undertakings.

For the foregoing reasons your petitioners most earnestly appeal to you to abrogate the Decrees of Mar. 1, 1915, and Aug. 31, 1915.

This is one of several strong memoranda which have been drawn by organizations of the Mexican mining people in the United States and in Mexico in an endeavor to obtain modification of the excessive taxation that has been heaped on the mining industry.

Development of Dredging in Yukon Territory*

SYNOPSIS—Dredging in the Yukon began on Lewes River in 1899 with 3½-cu.ft. buckets; today dredges with 16-cu.ft. buckets are operating in the Klondike River valley. Steam thawing of frozen ground was one of the important developments in the Northern dredging field, having greatly extended the dredgeable area and reduced the wear on the dredges. Conditions are extremely variable and heavy equipment is the rule. Operating costs of the Yukon Gold Co. for the last six years are given.

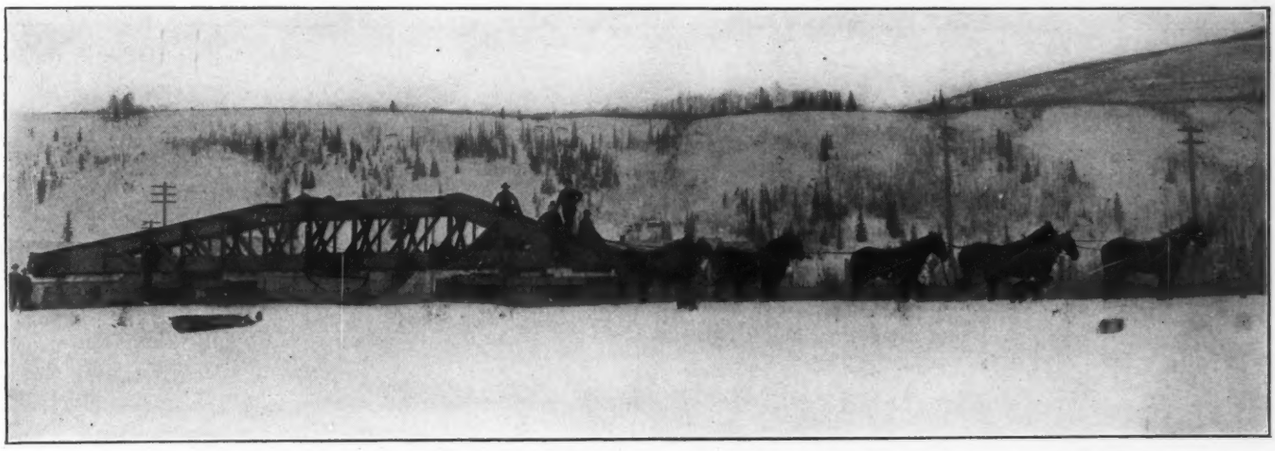
The first dredge in the Yukon was a small, 3¼-cu.ft. bucket, New Zealand-type dredge built on Lewes River in 1899. In 1901 it was moved and rebuilt on No. 42 Below on Bonanza Creek, and in 1903 moved to the Discovery group. This dredge, which was practically obsolete by 1905 and entirely unsuited for the work, proved the practicability of dredging on the Klondike creeks. The next dredge to be built was the Canadian-Klondyke No. 1, a 7-cu.ft. dredge which began operation in August, 1905, in the valley of the Klondike River, opposite the mouth of Bear Creek. These two dredges may be said to have shown the way to the large development which followed.[1]

The first three dredges of the Yukon Gold Co. were built on Bonanza Creek in 1906 and began operation early in 1907. These were followed in 1907 and 1908 by four 7-cu.ft. bucket dredges, two on Bonanza and two on Hunker Creek. In 1910 the Canadian-Klondyke Mining Co. built the first of its 16-cu.ft. dredges, which began operation in November of that year. In 1911 the Yukon Gold Co. built two all-steel dredges, each having 7-cu.ft. buckets. The Canadian-Klondyke company in 1913 built Nos. 3 and 4, both 16-cu.ft. machines. This comprises the dredging equipment now in use in the Klondike field. In 1907 two Risdon dredges were built on Walker's Fork, one of which was later moved to Miller Creek, where it is now operating, and a dredge was installed on the Bonanza Basin which has since been abandoned.

Electric Power Essential to Economical Operation

In order to operate successfully, and within the limit of expense, electric power was a necessary adjunct to the dredging. In 1906 the Yukon Gold Co. installed a 2,000-kw. hydro-electric plant at the junction of the Twelve Mile and Little Twelve Mile Rivers, 32 mi. from Dawson. The Granville Power Co. followed four years later with a plant on the north fork of the Klondike River. The Canadian-Klondyke company takes its power from this plant.

In terms of investment, the Yukon Gold Co.'s first seven dredges cost $1,000,000. The power plant cost $550,000 and the two all-steel dredges $500,000 more, making a total investment in dredging equipment alone of over $2,000,000. The three large dredges of the Canadian-Klondyke company are estimated to have cost $475,000 each. The power plant of the Granville Power Co. cost over $1,000,000. These figures do not take into account investment in shops, buildings, and accessory plant.



HAULING THE DIGGING LADDER OF DREDGE NO. 5 OVER A WINTER ROAD IN THE YUKON

In order to make a success of a dredging enterprise so far from the source of supply, the equipment must be complete and of the best possible kind. A single breakdown or loss of a part which could not be replaced might mean the loss of a season's work, so that the supply of extra parts and the shop equipment for repairs is much greater than ordinarily required.

Generally speaking, the dredging equipment does not differ greatly from the equipment in use in California. The machines follow the lines of the dredges developed in California, but, in the building, were increased in strength of parts over anything of the size previously built. The service is extremely severe and the season short, so that all digging and working parts subjected to strain are reinforced and made heavier than is usual in dredging practice. The best of material is used; all important shafting is of nickel steel, the buckets are of chrome-nickel

*A paper presented by O. B. Perry at the seventeenth annual meeting of the Canadian Mining Institute, Toronto, Ont. This will be printed in the annual volume, prior publication being granted the "Journal" by courtesy of the Institute Council.

[1]T. A. Rickard, "Min. and Sci. Press," Aug. 12, 1908.

steel or of manganese steel; the pins are of high-carbon steel, nickel steel or chrome-nickel. The tendency has been to increase continually the strength, and, therefore, the weight of the principal parts. The last two dredges built by the Yukon Gold Co. of all-steel construction are 20% heavier than anything of the size in use at present.

Two Classes of Gravels Dredged

Dredging in the Yukon is now being conducted on two classes of deposits, river valley and creek beds. The deposit in the valley of the Klondike River is, where thawed, well adapted for dredging. The material is free wash gravel, rounded and clean, averaging from 30 to 40 ft. in depth. The bedrock is sufficiently decomposed to be dug with ease. The top burden, in the thawed portion of the deposit, has been largely removed by stream action and presents little or no difficulty to dredging.

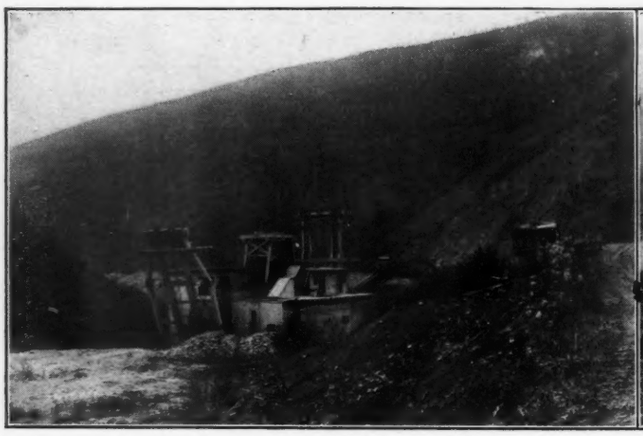
The creek deposits present altogether different characteristics. The deposits are shallow, for the most part ranging about 18 to 20 ft. to bedrock. The gravel is angular and contains little sand. The gold is confined almost entirely to bedrock. The creek gravels are overlain by a deposit known locally as "muck," which is made up of organic matter, fine sand and water, almost invariably frozen, and, where undisturbed, covered with a blanket of moss. The depth of the covering of muck is from 4 to 8 ft., with an average of about 6 ft. In the dredging operation on the creeks it is necessary to take up from 4 to 6 ft. of the bedrock itself, which is a sericite schist and usually massive and blocky in character.

Operations in the Yukon district are subject to difficulties which are not met elsewhere, except in Alaska. These may be described under two heads: (1) Climatic; (2) character of deposits.

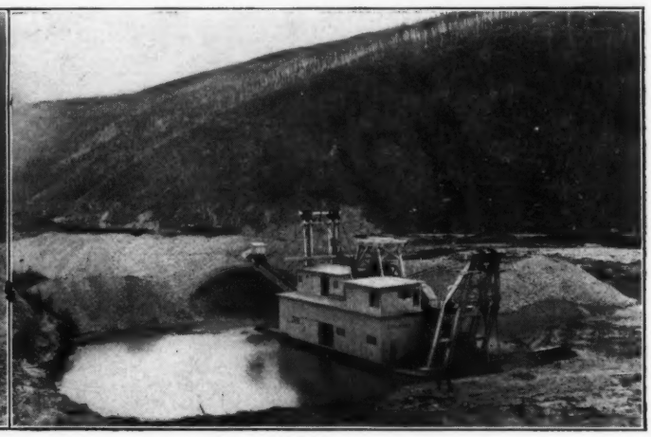
The extreme cold of the Northern winter limits the operation to an open season of about six months. Dredging cannot be begun until there is sufficient thaw to produce water for flotation and to clear the ponds of the winter ice, which forms to a depth of from 5 to 7 ft. Both the start and finish of the seasonal operation are hindered by cold. All moving parts, such as the tailings conveyor, must be housed in and warmed by steam coils. Also, steam is used freely to keep the ladder and bucket line clear and to keep the gold tables in good condition. The dredging operation is terminated when the creeks freeze to such an extent that water for flotation is no longer available.

The creek deposits present many obstacles to dredging. In the first place, the deposits are shallow, which causes many moves of the dredge, both "stepping ahead," as the operation is called, and side moves across the pond. The shallow ground also increases the labor for outside work, such as setting "deadmen," removing stumps, etc. The muck itself is not difficult to handle, if thawed, particularly if sandy in character, but it often carries, buried in it, stumps, roots and other material, which tend to choke the feed hoppers and cause delays. Digging the bedrock in order to recover the gold is the most difficult part of the process. It is slow, hard work that entails heavy wear on the entire machine and causes continual replacement of all digging parts. The greatest obstacle to dredging is the frozen condition of a large percentage of the creek gravels, which condition must be removed before dredging operations can be successfully conducted.

The short season during which it is possible to operate has led to many departures from usual methods. The determined effort is to get all that is possible out of the dredges in the short time allowed, and the result is a remarkably high efficiency for the time the machines are operated. For example, last season the dredges of the Yukon Gold Co. averaged 87.2% of the possible running time, as compared to a fair California average of 78%. Each season has shown a gain in yardage per dredge-hour over the season previous, until the present rate is higher in most cases than that of dredges of the same size in California, where conditions are much more favorable.



NO. 7 DREDGE ON UPPER HUNKER CREEK



NO. 3 DREDGE ON BONANZA CREEK

The No. 7 dredge completed its work on Upper Hunker Creek in 1911, and was then dismantled and removed to the Iditarod district, Alaska, where it has since had a remarkable yield from the rich ground on Flat Creek

How Repair Work Is Conducted

The California practice is to run the dredges continuously until they get to the point of requiring a complete overhauling, when they are shut down for 10 days or two weeks and the necessary repairs made. In the Northern practice this is changed. All the heavy repair work is done in the closed season. In the autumn, when work is suspended, the dredges are stripped of their bucket lines and conveyors. The buckets, screens, pumps and all parts subjected to heavy wear are taken to the shops and thoroughly overhauled. The dredges are put in a state of as nearly perfect repair as possible before the season opens

MACHINE SHOP AND WAREHOUSES OF THE YUKON GOLD CO. ON BONANZA CREEK

Dredge tailings and two dredges in background

POWER HOUSE OF YUKON GOLD CO. IN WINTER AND IN SUMMER

This power plant is situated on the Little Twelve Mile River. It contains three Pelton impulse wheels direct connected to three 650-kw. Westinghouse generators and supplies power to eight dredges, the machine shop and for other miscellaneous requirements

Machinery warehouse during flood of 1910 View below the power house in the spring of 1910

SPRING CONDITIONS THAT HAD TO BE MET IN THE YUKON IN 1910

and then operated with a view to keeping them going throughout the season.

During the operating season all repairing upon the dredge is minimized. Instead of replacing worn bucket lips on the dredge a few at a time, as is often done, the entire bucket line is taken off and replaced by another line which has been re-lipped and entirely overhauled. This operation requires only a few hours. The worn buckets are then hauled to the shop, repaired and kept on hand for the next replacement. If the distance to the shop is too great, the buckets are repaired on the ground by a shop crew. Portable compressors and special tools are provided for this work. The same method is used with lower tumblers and other parts exposed to heavy wear. When the lower tumbler plates become worn, instead of replacing the plates, the tumbler itself is removed and a newly repaired tumbler substituted. The old tumbler is then sent to the shop or repaired and replated on the ground, as the case may require. Each autumn all belting is taken off and sent to warm storage.

Strengthening Dredge Parts

Many detail changes have been made in the dredge machinery. The buckets have been re-designed several times since operations began. Some parts have been found to be inadequate for the heavy work. The digging ladders have all been reinforced and heavily shod on the bottom, screens rebuilt, pump capacity increased and sluices and gold-saving apparatus changed and improved.

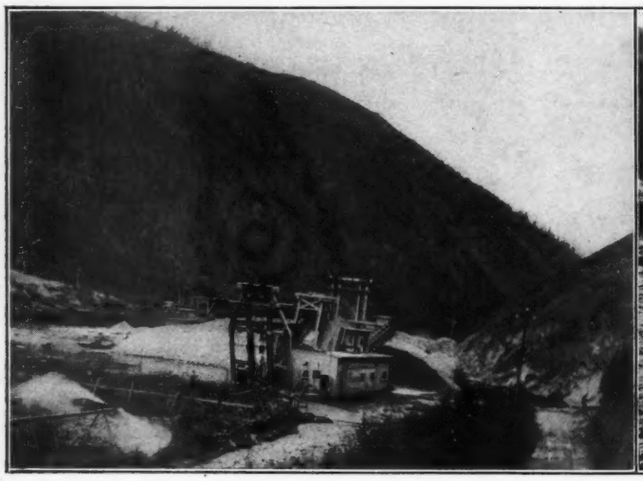
The closest possible supervision is kept over the running time and performance of the dredges. Each dredge is connected by telephone with the dredge office and reports its running time and stoppages daily. The superintendence is so arranged that the superintendent or his assistant visits each dredge at least once per day, and is on hand for any unusual repair jobs. In case of a shutdown for repairs, if only for a few hours, the crews are doubled up and shopmen sent out for any special work. Electrical repairmen are on hand day and night for any failure or trouble in the electrical apparatus.

As a further stimulus to increasing the dredging rate, a bonus system was tried during the season of 1912, but abandoned. The conditions varied so widely from one dredge to another, and the dredges being of a different age and in different condition made it difficult to arrive at a satisfactory standard of measurement. The bonus did not act as a stimulus, but rather aroused antagonism. The operators are all picked men, who get higher pay than they receive on other dredge operations, and a trip north, which they like. No further incentive seems necessary for the men to give the best that is in them.

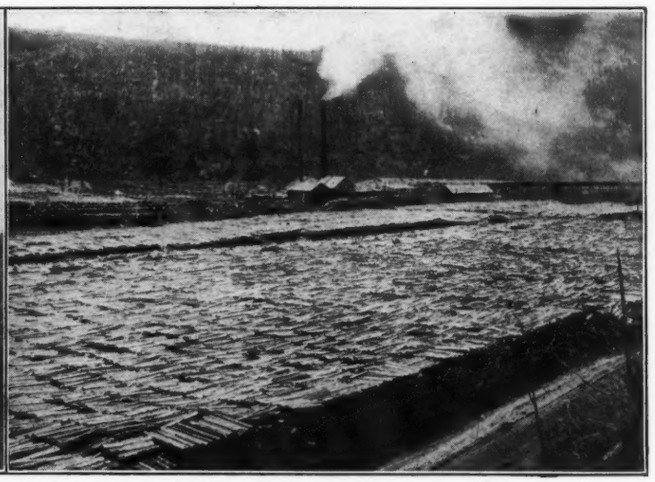
As illustrating the improvement in dredging in the Klondike since its inception, No. 5 of the Yukon Gold Co. dredged last season through the tailings of the old Lewes River dredge and made a good profit. This dredge took up 2 to 4 ft. of bedrock which the old dredge was unable to handle and obtained a good yield in ground that had been worked by hand by opencut methods before being dredged by the small dredge.

Frozen Ground the New Problem in the North

While the short season and severe service have led to numerous improvements in detail and to increases in strength and size of the dredges, and continue to offer problems which the dredge operator must meet, the greatest development in the Yukon as compared to the ordinary dredging operation has come in the handling of frozen ground. The heavy bedrock encountered on the creeks and the necessity of digging it to considerable depth to recover the gold were in themselves serious matters. No experienced dredge operator would have thought, in the beginning, that any dredge could handle the bedrock which the machines are digging today with comparative ease. When the business was further complicated by having large areas solidly frozen, the problem of dredging such areas at a profit became one of extreme difficulty. The results of attempts to dredge partly thawed areas and frozen bedrock were enough to show that the frozen condition must be completely changed before dredging could be successful. Necessity compelled the adoption of the present method of thawing, which is the development, on a wholesale plan, of the method which was in use in the drift mines in the Klondike before dredges were thought of. Preparing the ground for dredging by thawing with steam was an entirely new feature of dredge mining, and the success of the method has made millions of yards of gravel available for dredging which could not otherwise be worked at a profit.



TWO DREDGES ON UPPER BONANZA CREEK; THAWING PLANT IN FOREGROUND



OVER 7,000 CORDS OF WOOD STORED ON THE ANDERSON LEASE FOR THAWING

The steam point as originally used was a short piece of ⅜-in. pipe drawn down at one end to a point with an orifice left for the steam to escape; the other, or head end, had a nipple welded to it for steam-hose connection. The point, with steam turned on, was gradually driven into the face of the drift, then allowed to steam until the bedrock and gravel were thawed to the height of the drift. From two to six points were used in each breast, spaced from 1 to 2 ft. apart. This simple operation contained the essential features of the method whereby over three million yards of gravel are now being thawed in a season.

Thawing to a Depth of 40 Feet

In the thawing operation for dredging, the points are driven from the surface down through muck and gravel and into the bedrock from 4 to 6 ft. The points were gradually lengthened in practice, first, to 24 ft., then to 30, and last season were being successfully driven 40 ft. to bedrock. The points are made up of triple-extra-heavy hydraulic pipe with drop-forged head and tool-steel tip. The small boilers first used have been replaced by larger sizes until the boiler equipment now comprises eight plants with a total boiler horsepower of over 2000. The 150-hp. locomotive type has been adopted as the unit, and the plants usually consist of a pair or, sometimes, three such boilers.

The preliminary work for each season takes the following form: (1) The dredgeable area ahead of each boat is barred for frost. From the bar-hole results the naturally thawed and frozen areas are blocked out. The bar tests are checked by drilling where thought necessary. (2) Surveyors "pick up" the thawed areas which are mapped, and planimeter measurements are made of the frozen areas. (3) The estimated course of the boat is laid out for the year and its probable position calculated for each month of the season. (4) The total square yards of frozen ground which the dredge will dig in a season is measured from the map on which the season's work is laid out and the necessary wood for thawing is determined and its location decided.

The "sweating" of the naturally thawed ground must also be taken into account. The duty per cord, both in thawing and in sweating, to dispose of the surface frost, has been determined by experience. Knowing the square yards of frozen ground to be thawed and the area of naturally thawed ground to be "sweated" and the duty per cord of fuel, the total fuel requirement for the season is a simple computation.

The thawing operation has been described elsewhere[2], so that I need only give the sequence of events in a normal operation: (1) Steam-line boxes are strung out by horses, if they are available, otherwise men are used; (2) gooseneck boxes and headers coupled on; (3) bar-holes for starters put down; (4) starters used to thaw holes about 8 ft. deep; (5) starters pulled and long points placed in starter holes; (6) points driven down through gravel and into bedrock; (7) points allowed to steam in bedrock from 12 to 48 hr., depending on the formation; (8) points pulled, cleaned and straightened; (9) header moved and starters put down and cycle begun again.

The improvements that have been made in steam thawing since it was adopted for large-scale dredging operations are too many to attempt to detail in a short paper. They have taken the following general lines: (1) Reduction in fuel; (2) increase in efficiency of hose and points; (3) reduction in cost of driving.

The fuel has been reduced by improving the quality, reducing the radiation losses, purifying the feed water and improving the combustion. Experiments were made both with coal and fuel oil as a substitute for wood. The points have been greatly improved in material and manufacture, and the hose has been improved in quality and its life increased. Metal hose has been used for this work with success. The cost of driving has been reduced by improvement in the method of driving, correct spacing of points and correct pressure and amount of steam.

Costs Vary Widely Owing to Different Conditions

The question most often asked in connection with dredging in the North is: What does it cost to thaw and dredge frozen ground? This is a difficult question to answer on account of the wide variation in conditions. All of the creek deposits contain some areas of naturally thawed ground. The percentage of frozen and thawed areas varies on the same stream, and still wider variations occur from one stream to another. This variation reflects itself in the cost per cubic yard, the cost going up or down as the percentage of frozen ground increases or diminishes.

Another variable factor is the cost of thawing or preparing the frozen ground for dredging. Thawing on Hunker Creek, for example, is a much more difficult and expensive operation than thawing on Bonanza. In 1911 the thawing for dredge No. 4 on Hunker Creek cost $2.18 per sq.yd. as against $1.085 ahead of No. 5 on Bon-

TABLE 1. THAWING COST, YUKON GOLD CO., 1909–1914

Year	Total, Sq.Yd.	Frozen, Sq.Yd.	Naturally Thawed, Sq.Yd.	Naturally Thawed, %	Thawing Cost in Dollars	Cost of Thawing per Sq.Yd.
1909	298,061	212,903	85,158	28.6	$275,112	$1.5571
1910	396,837	256,033	140,804	35.5	500,689	1.7727
1911	555,393	432,693	122,700	22.1	696,034	1.6166
1912	692,522	509,574	182,948	26.4	804.854	1.455
1913	651,505	445,624	205,881	31.6	685,570	1.546
1914	586,737	402,660	184,077	31.4	602,174	1.428

TABLE 2. DREDGING AND THAWING COSTS, YUKON GOLD CO.

Year	Cu.Yd. Dredged	Thawing Cost per Cu.Yd., Cents	Percentage of Thawing Cost of Total	Total Cost per Cu.Yd., Cents
1909	2,381,880	15.45	48.37	31.94
1910	3,249,788	14.14	45.57	31.09
1911	4,151,249	17.62	49.72	35.43
1912	5,157,280	15.02	49.03	30.64
1913	5,133,575	13.57	45.94	29.53
1914	4,800,781	12.18	44.09	27.62

TABLE 3. DETAIL OF 1913 THAWING COSTS

	Total Expenditures	Cost per Sq.Yd., Cents	Percentage of Total
Fixed salaries	$ 1,614.00	0.4	0.23
Labor	289,195.38	65.2	42.18
Fuel	295,928.03	66.7	43.17
Shop expense	1,722.16	0.4	0.25
Preliminary expense	36,021.74	8.1	5.25
Material and supplies	23,180.50	5.2	3.38
Stables	6,589.27	1.5	0.96
Transportation	198.00	0.1	0.03
Miscellaneous	380.33	0.1	0.06
Depreciation	30,731.37	6.9	4.48
Power	9.45	....	0.01
	$685,570.23	154.6	100.00

Square yards thawed, 443,567.
Number of points driven, 63,004.
Cost per point driven, $10.881.

TABLE 4. THAWING AND DREDGING COSTS OF INDIVIDUAL DREDGES OF YUKON GOLD CO.

Dredge	Situation	Percentage of Area Naturally Thawed	Thawing Cost per Cu.Yd., Cents	Total Cost per Cu.Yd., Cents
No. 1	Bonanza	22.1	12.55	31.93
No. 2	Bonanza	34.6	12.28	32.55
No. 3	Bonanza	14.0	18.36	33.79
No. 4	Hunker	7.2	17.95	32.11
No. 5	Bonanza	44.8	12.34	27.01
No. 6	Bonanza	18.6	16.38	33.36
No. 8	Upper Bonanza	33.7	12.97	27.92
No. 9	Eldorado	58.6	7.49	21.16

[2]T. A. Rickard, "Min. and Sci. Press," Sept. 12, 1908.

anza. The depth being practically the same, the cost of thawing per cubic yard was twice as great in the one case as in the other. Purely local conditions govern this cost, such as depth of ground, character of material, ease or difficulty in driving, time of steaming, cost of fuel, etc. Since the gold, practically speaking, is all confined to the bedrock, the cost per square yard of bedrock thawed becomes the controlling factor in determining what ground can be dredged at a profit and what must be left.

The appended tables show the thawing and dredging cost for the last six years of the Yukon Gold Co.'s operation. Table 4 shows the variation in working cost for the different dredges in one season. As the conditions change, the dredge holding the lowest cost for one season may show the highest cost for the next. When the costs for the eight dredges are totaled and averaged the results over several seasons are remarkably uniform.

While Table 1 shows a gradual reduction in the thawing cost, it does not reflect the improvement in efficiency, which has been marked. It is a rare occurrence now for a dredge to strike a piece of ground that is not thoroughly thawed. The improvement in this direction is shown by the gain in duty per dredge-hour, which increased from 162 cu.yd. per hr. in 1910 to 204 cu.ft. per hr. last year.

I have previously referred to the operation of the Canadian-Klondyke company in the Klondike River valley. This company has built three 16-cu.ft. dredges, the largest size in use in California. The dredges have operated into December, making a total working season of 270 days. The president and general manager claims for the big dredges an operating cost of 6c. per cu.yd. No detail has been published showing how this cost is computed. As previously set out, the Klondike River gravels, where thawed, present exceptionally good conditions for dredging. It is doubtful, however, if as low a cost as 6c. per cu.yd. can be reached if the same items are included as given in the cost figures appended hereto. In the 1913 operation of the Yukon Gold Co. the items of gold tax and selling charges alone amounted to 1.98c., or practically 2c. per cu.yd. Depreciation, taxes, insurance, etc., add another 2c. in fixed charges, which would leave only 2c. per yard for labor, power, repairs and supplies if a 6c. cost were to be realized in this operation. However the costs of the Canadian-Klondyke company may be computed, they are undoubtedly low, and the company has contributed greatly to the development of dredging in the Yukon.

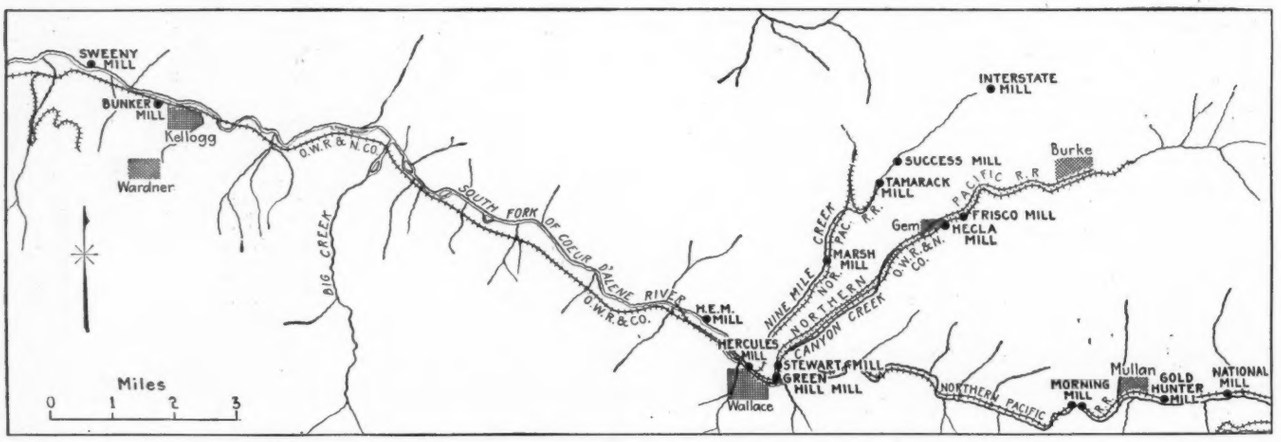
The development of another method I have not touched upon, as it is, as yet, untried for any large-scale operation, that is, the preparation of large areas of frozen gravel by the stripping method, or so-called "natural thawing." This method has been fully dealt with in a recent article[3] by E. E. McCarthy, who reports the results of the large-scale experiments conducted by the Yukon Gold Co. in 1906, 1907, 1908, and shows why the results were not such as to lead to the adoption of the method for its operations.

The dredging operation of the Yukon Gold Co. has added over $16,000,000 in gold to the wealth of the world; other companies have produced over $4,000,000, making a total of about $20,000,000 for Yukon dredging in less than 10 years of life.

[Since this paper was written, the total production mentioned in the last paragraph has been increased by about $4,000,000.—Editor.]

Flotation at Gold Hunter Mill

The Gold Hunter mine and mill, owned by the Gold Hunter Mining and Smelting Co., are situated in Hunter Gulch, about a mile northeast of Mullan, one of the mining communities of the Cœur d'Alene district. The orebody lies in the line of continuation of the Morning and You Like veins of the Morning Mine of the Federal Mining and Smelting Co. The mine has been operated since 1884, and while it originally produced high-grade silver ores, it is now in the same condition as the rest of the older mines of the camp, working on the comparatively low-grade and complex orebodies of the sulphide zone.



MAP SHOWING THE SITUATION OF THE PRINCIPAL CŒUR D'ALENE MILLS

Having approximately the same orebodies that exist in the Morning property, it is not surprising that the Hunter ores are complex and difficult to treat. The minerals known to be present are galena, sphalerite, pyrite, tetrahedrite, stibnite, siderite, barite and quartz. These minerals are unevenly distributed, and all of them do not occur in the general run of ores, although highly complex bodies containing many of them are sometimes encountered. As compared with the general character of the ore treated by the Morning mill, the Hunter ore supply contains more pyrite and less galena, but has a somewhat higher percentage of silver. In common with all the complex ores of the district, a great deal of difficulty

[3] "Min. Mag.," April, 1914.

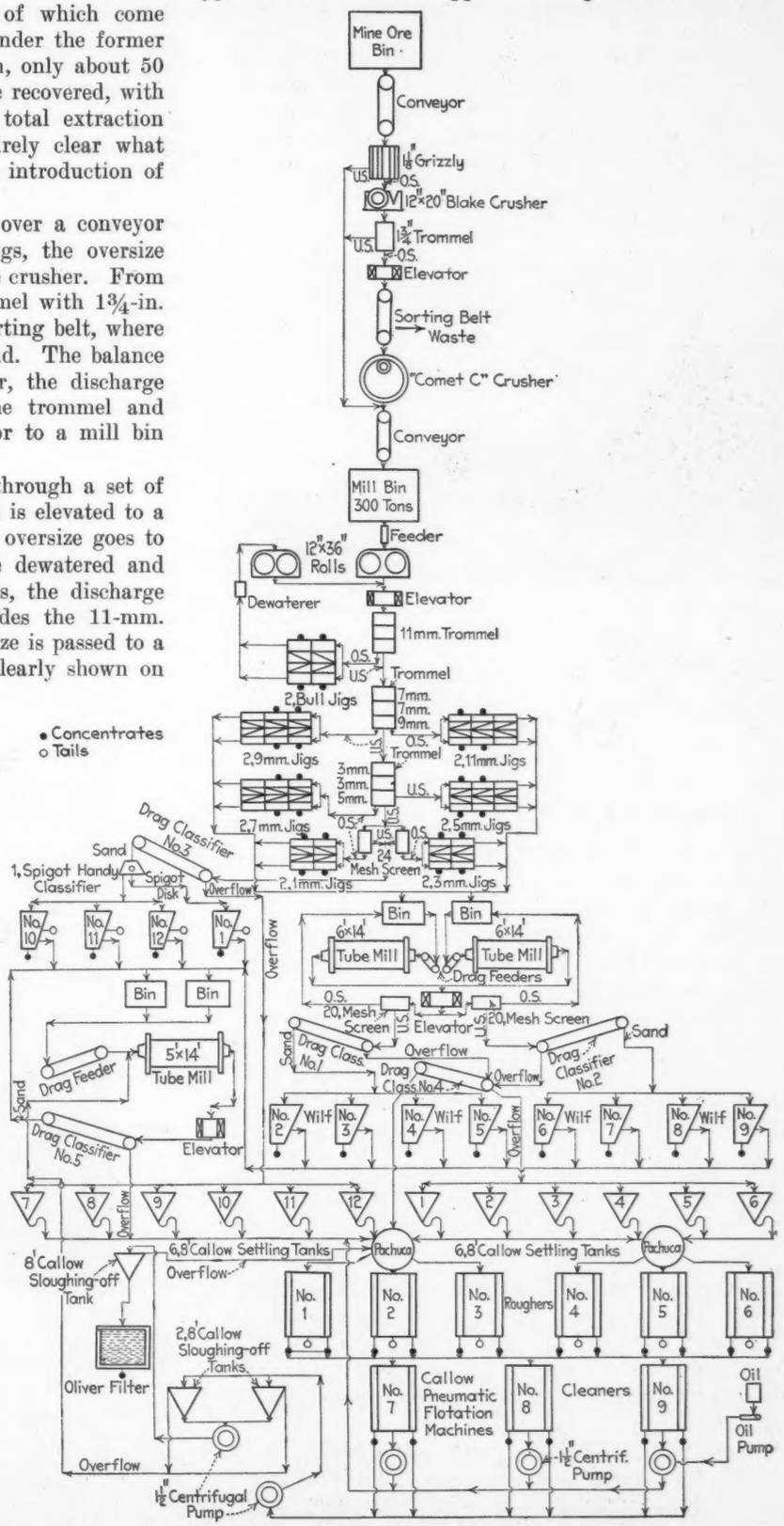
has been found in treating the Hunter ores profitably, and it may be said that not until flotation became a permanent part of mill treatment was continuously profitable operation possible.

The Gold Hunter mill at the present time treats about 310 tons of ore per 24 hr. From this about 35 tons of concentrates are produced, about half of which come from the flotation department. While under the former system of table and vanner concentration, only about 50 to 60% of the valuable minerals could be recovered, with the addition of the flotation units the total extraction has risen to 80%, thus making it entirely clear what a great difference has been made by the introduction of flotation in this district.

Ore from the mine-ore bin is passed over a conveyor belt to a grizzly having 1⅛-in. openings, the oversize of which is put through a 12x20-in. Blake crusher. From the crusher the material goes to a trommel with 1¾-in. holes, the oversize being elevated to a sorting belt, where a portion of the waste is removed by hand. The balance of the oversize goes to a Comet crusher, the discharge of which meets the undersize from the trommel and grizzly and is carried on a belt conveyor to a mill bin having a capacity of 300 tons.

From the mill bin the ore is passed through a set of 12x36-in. rolls, the discharge from which is elevated to a trommel having 11-mm. openings. The oversize goes to two bull jigs, the tailings of which are dewatered and crushed in another set of 12x36-in. rolls, the discharge going back to the elevator which precedes the 11-mm. trommel. From the trommel the undersize is passed to a set of screens and jigs, the flow being clearly shown on the accompanying flow-sheet drawing. The sand is dewatered in a drag classifier and concentrated on four Wilfley tables, the concentrates from which are collected in a bin. The table tailings are then reground in a 5x14-ft. tube mill, elevated, dewatered and reconcentrated. The flow from the jigs is reground, classified and concentrated on Card tables, as is shown in the flow sheets. At this point preparation is made for treating the tailings from the concentrators by flotation. The pulp is thickened in Callow settling tanks and then delivered into two small Pachuca tanks, where mixture with the frothing oil is accomplished. Creosote oil in the proportion of about ⅓ lb. per ton of ore is mixed in the tanks and then delivered to six Callow roughing flotation machines. Three of these are supplied by each of the Pachuca tanks. From the roughing machines the concentrates are sent to three Callow cleaners, these being machines of the same type as the roughers. Each of them is supplied by two of the rougher machines. The concentrates, finally cleaned, are pumped into two 8-ft. Callow sloughing-off tanks and then to a third Callow cone, whence they are delivered to an Oliver filter. The filter delivers concentrates containing only about 8% of moisture. All solutions from the flotation department are returned to the Pachuca tank for further use, the object being to avoid the loss of any oil that may remain in them.

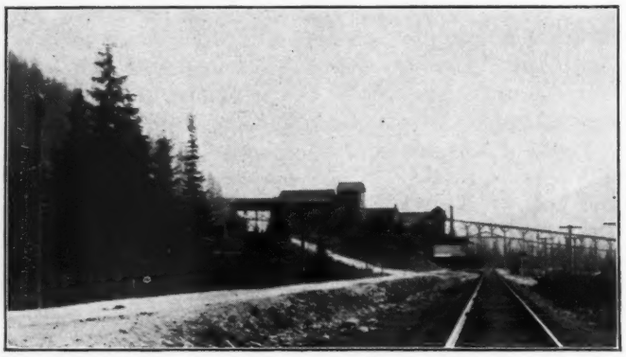
The Callow machines are of the well-known light-froth type in which air is supplied through a filter bottom



FLOW SHEET OF THE GOLD HUNTER MILL

into the frothing cells. In this case the air pressure is about 8 lb. per sq.in., this pressure supplying sufficient buoyancy to keep a froth continually overflowing the cells.

Among the important points brought out in the practice of flotation at the Hunter mill is the absolute necessity of giving a great deal of care and watchfulness to the small details of operation. The flow of pulp to the roughing and cleaning machines must be absolutely constant in quantity, and what is even more important still, the dilution must be constant. At this mill the pulp is comparatively thick—that is, contains a high percentage of solids—but as a general rule of flotation this does not apply, since different dilutions may be necessary for the successful working of different kinds of ore. It is important, however, that after the proper working conditions have been determined, they shall be maintained absolutely to get proper results. The accompanying flow sheet shows clearly all the details of the operations of the Gold Hunter mill.



THE GOLD HUNTER MILL, NEAR MULLAN, IDAHO

Buys Ore Lands in Cuba

The Midvale Steel and Ordnance Co. announced Dec. 8 that it had obtained 300,000,000 tons of iron ore in Cuba through the purchase of all the stock of the Buena Vista Iron Co. The property owned by this concern lies adjacent to holdings of the United States Steel Corporation and the Pennsylvania Steel Co.

The company stated that improvements planned would entail the expenditure of more than $6,000,000. Those already outlined call for six new openhearth furnaces, a blooming mill and two turbo-generators for the Worth Brothers Co.'s plant at Coatesville, and of several additions to the Midvale plant at Nicetown, at a total cost of $2,380,000. The new facilities will enable the company to handle orders recently obtained from the Government for 14- and 16-inch guns 70 ft. in length.

Broad Pass Region of Alaska

Broad Pass is the western part of a wide glacial valley which is bordered by steep, straight mountain walls lying parallel with a great east-west range on the north and connecting the upper valleys of Chulitna and Susitna Rivers.

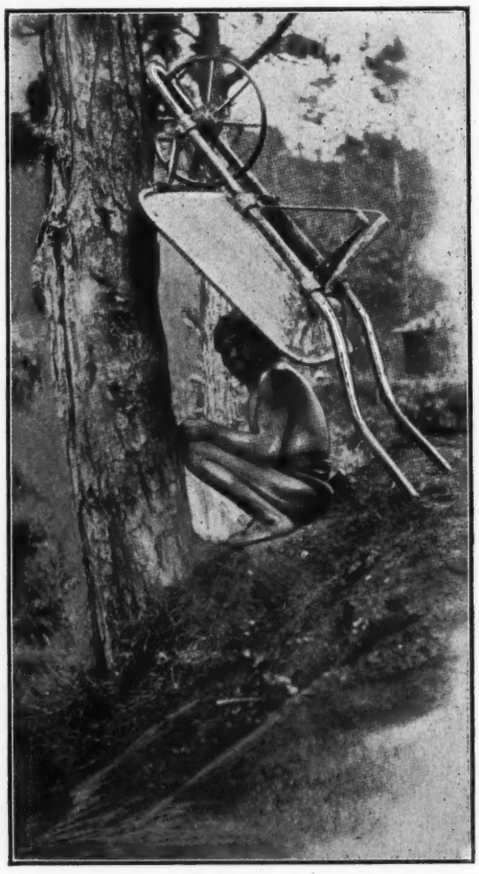
The geologic conditions in the region appear to be favorable to mineralization, but no valuable orebodies have yet been discovered. The most favorable reports came from the district just west of Broad Pass, near the head of Chulitna River, where prospecting has been carried on for several years. Valdez Creek, an important gold-placer district, lies about 30 mi. east of the pass. Along some of the streams between Broad Pass and Valdez Creek there are prospects of placer gold, which, however, has not been found in commercial quantity. Copper prospects, too, have been discovered in several parts of the rigion, and at one place, Coal Creek, there is a small area of coal.

The railroad, which will probably soon reach this region, will aid greatly in its development. The wealth of the Broad Pass region appears to be mineral rather than agricultural, and it can be profitably exploited only by a greater population and through better means of transportation.

The district is described fully in Bulletin 608 of the Geological Survey.

Safety First, Igorot Variety

The modern Safety-First idea, when applied by an aboriginal, does not always effect the security which it was intended to do, as shown by the accompanying illustration from the current issue of the Pan-American Union. The Igorot roadbuilder is safely(?) hiding under a modern American iron wheelbarrow upturned, awaiting the result of a blast on some road work nearby. He is showing the atavistic instinct of the ostrich by being apparently perfectly content with his safety precautions when he has protected his head from the flying rock, while the honorable torso is wholly exposed between the handles of the wheelbarrow.



SAFETY-FIRST POSE OF AN IGOROT

Details of Practical Mining

Compressed-Air Equalizing System at Copper Queen

By Fred M. Heidelberg*

Power for the Copper Queen Consolidated Mining Co., Bisbee, Ariz., was generated formerly at five of the company's shafts. About the middle of 1908 a central power house was built. Five 400-hp. Stirling boilers, with economizers and superheaters attached, were to furnish the steam, two 3,500-cu.ft. per min. Ingersoll-Rand compressors were to supply the air, while three 500-kw. Curtis vertical turbines were to furnish the electrical power.

The air consumption was the big variable and worked the greatest ravages on the plant. The compressors were connected directly to the air system. The governors on all compressors were controlled so as to keep the pressure about 90 lb. gage. The equipment using air consisted of three hoists—one Sullivan, one Fraser & Chalmers and one Nordberg—several hundred air drills and many other kinds of minor hoists and air machines distributed about the different shafts. It was found that since the Gardner hoist was so far from the power house, it could be run more economically on air than steam; therefore air was used, thus adding another Sullivan hoist to the air-consuming engines. More mine development made it necessary to install a 7,000-cu.ft. per min. Nordberg compressor to take care of the increased air requirements. The average consumption of air during the year 1912 was about 10,000 cu.ft. per min., while the maximum and minimum instantaneous requirements of the compressors were 14,000 and 2,000 cu.ft. per min. respectively. The minimum would take place between shifts when no air-using machines would be working. One 3,500-cu.ft. compressor would run at little more than half speed. The maximum was furnished when all three compressors were running at full speed.

Naturally, the maximum instantaneous supply would take place when all hoists and most of the drills were working at the same instant. The demand on the air system would be so great that all the compressors would jump from about half speed to full speed. Besides the undue racing of the compressors the demand on the boilers would be strong, since 30 lb. of steam for the Nordberg compressor and 40 lb. of steam for the Ingersoll-Rand compressors were required to produce 1,000 cu.ft. of air. Also, the air pressure would drop from 90 lb. to below 65.

Such conditions mean tearing the plant to pieces. Consequently, after a thorough investigation it was decided to install an air-storage and balancing system which would store up the air when consumption was light for use when the air consumption was large and keep the pressure nearly constant through a great part of the storage. This would allow fewer compressors in use and allow them to be run at a nearly constant speed.

General Features of the Design

In essence the plant consists of a steel-tank storage for air kept at a nearly constant pressure by a hydrostatic head.

The layout is shown in Fig. 1. The storage consists of six tanks, 9 ft. in diameter, 40 ft. long, spaced 11 ft. 6 in. centers. The volume of the six tanks is slightly over 15,000 cu.ft., and they will store approximately 115,000 cu.ft. of free air at 93 lb. gage.

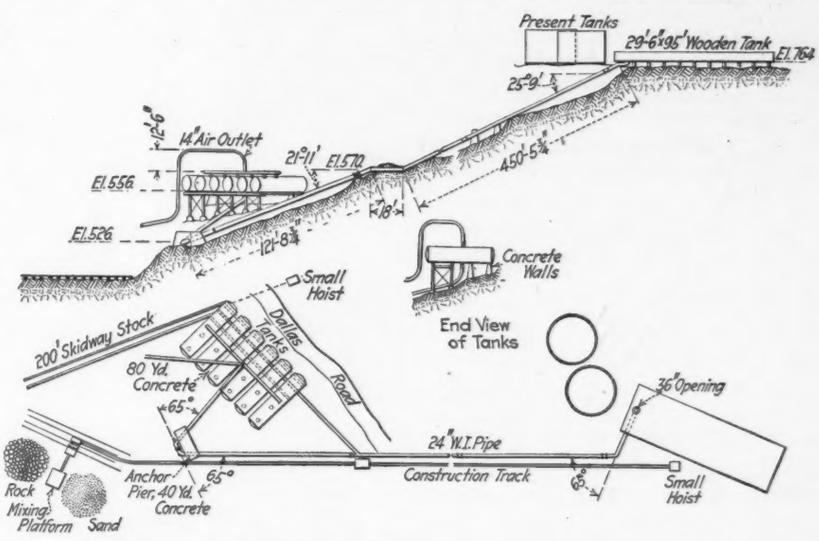


FIG. 1. GENERAL LAYOUT OF EQUALIZING SYSTEM

The air outlet at the top of each tank is 8 in. diameter and connects to a single-piece 14-in. header with 14x8 welded tees. The water inlet at the bottom of each tank connects to an 18-in. header by means of 12x18 tees welded to the header. This 18-in. header connects with the 24-in. line of the water tank by means of a 24x18 tee. The 24-in. line is of wrought-iron pipe and drops 30 ft. below the bottom of the tanks to form a U. At this U is a 24-in. gate valve. A 6-in. gate valve for draining and cleaning opens into the atmosphere at this point. From this U the pipe extends about 620 ft. to the wooden water-storage tank on top of the hill. The opening to the wooden tank is 36-in. and is connected by a 36x24 elbow.

There are five expansion joints in the pipe line, each allowing for a 2-in. expansion. Four of these expansion joints are between the U and the water tank and one between the U and the air tanks. Since one section of the long pipe is inclined at an angle of 21° 11′ and the other at an angle of 27° 11′, it would tend to slide down

*Box 1179, Bisbee, Ariz.

and close the expansion joints. Consequently an anchor pier 2x4 ft., top dimensions, extending with battered sides down to rock, was put in on the up side of each expansion joint to hold the upper section of pipe. Under each section of pipe a supporting pier 18 in. square on top was placed. At the U a large anchor pier was built. The pier was to have top dimensions of 6x21 ft. and was to extend with battered sides to rock not less than 4 ft.

Fig. 2 gives the details of the wooden water-storage tank. The dimensions are 29½x95x5 ft. The foundation

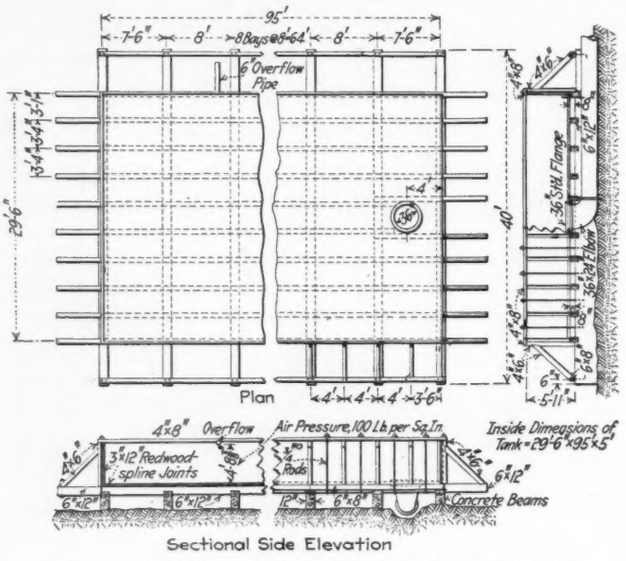


FIG. 2. DETAILS OF CONSTRUCTION OF WOODEN WATER-STORAGE TANK

consists of thirteen 12-in.-wide concrete beams spaced to make 95 ft. These piers are built on the rock and upon them were placed ten 6x12's spaced to make 29 ft. 6 in. The sides and bottom of the tank were lined with 3x12 splined redwood. The bottom of the tank was nailed to the 6x12's, while the sides were nailed to 4x6's. Braces of 4x6 were then inclined, as shown, to hold the sides plumb. A 4x8 cap was then placed around the entire periphery of the tank. Both a water outlet and inlet from the pump were provided.

The volume of the water tank is 2,800 cu.ft. per foot in height, which is slightly over one-fifth the volume of the air tanks. The total drop in head equals the drop in the water tank plus the rise in the air tank. The rise in the tanks varies for the same volume of water. At any rate one foot drop in head in the water tank displaces approximately 21,000 cu.ft. of free air at 93 lb. gage. This little example illustrates the delicacy of the system.

The water tank provides a large quantity of water with a small drop in head until the tank is empty. If there is just enough water in the system to bring the water to equilibrium when the air tanks are just full of water, the level of the water in the pipe will be about 108 ft. from the U, measured along the pipe. It is the volume from the bottom of the water tank to this point of equilibrium in the pipe that will produce the greatest drop in air pressure—that is, to zero gage. The length of pipe from this point of equilibrium to the bottom of the water tank is 512.2 ft., representing a volume of 1,630 cu.ft., approximately one-ninth the volume of the air tanks. This is a small quantity of air. It will be seen, therefore, that at no time should more water be put into the system than will just fill the air tanks at atmospheric pressure with the water at equilibrium.

The additional head of 30 ft. from the bottom of the air tanks to the U serves as a safety precaution. The air will just go around this point when the air pressure is between 103 and 105 lb. On a test at 103 lb. the system worked. When the pressure was raised to 105 lb. the air went around the bend and forced the column of water up with such force that part of the water-storage tank was wrecked.

The air tanks are supported at four places. The two back supports consist of concrete walls running under each tank. The two front supports are channel columns with channel struts between. The columns are directly under the tanks and were designed to take a load of 55,000 lb. each. Each tank rests in four cast-iron saddles, one over each support. Although the struts have no load to carry, they were designed to hold an empty tank at the center of the span, since the empty tank would be rolled over the beam in that manner while erecting. The curved air-delivery pipe is carried up 12 ft. 6 in. above the 14-in. header of the tanks to insure no water getting into the air system.

The distributing lines were located about as follows: In the power house the air discharge of all the compressors connected to a drum 4 ft. diameter and 80 ft. long. A 14-in. pipeline connected this drum with a smaller drain drum just outside of the power house. Two lines lead from this drain drum—one a 14-in. line connected to the balancing system several thousand feet away; the other, a 10-in. line, leads over to the Gardner shaft and

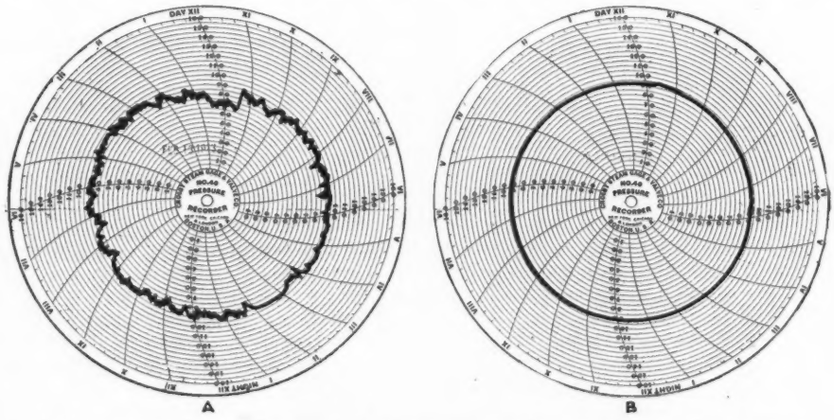


FIG. 3. CHARTS SHOWING PRESSURE CURVE BEFORE AND AFTER EQUALIZING SYSTEM WAS INSTALLED

supplies air to all the mines in the northern part of the camp. An 8-in. line connects to the 14-in. line near the balancing system, to furnish air to the Lowell shaft. Drain drums were provided wherever there was a dip in the pipe lines.

Constructing the concrete piers was simple. The concrete-mixing plant was located at the end of the railway spurs shown in Fig. 1. From this point to the top of the hill a construction track was run parallel to the pipe line. A small hoist was located on top to pull up mate-

rial. On the opposite side skids were installed with hoist, to handle the heavy tanks and material. The concrete was distributed as follows: Foundation beams under wooden water-storage tanks, 30 yd.; piers under pipes, 30; the anchor pier at U, 40; walls and piers under tanks, 80; total, 180 yd. The timber in the tank on the hill amounted to 22,400 ft. b.m.

In order that the right amount of water should be got in the reservoir, a set of gage-glasses were connected to one tank of the battery so that the height of water in the air tanks could be ascertained. By closing the gate valve the water in the storage tank could be kept from varying until enough new water could be added to bring the quantity to the required amount. Outside of keeping the required amount of water in the tank, the system gives no trouble. Its operation is automatic, and the pressure rarely varies over three pounds.

By way of comparison, two pressure charts are shown in Fig. 3. Chart A is an average one before the balancing system was installed, and shows the great variations in pressure in the air-supply system. It will be noted that in one place the pressure dropped and it was more than an hour before it could be brought up again. Chart B, on the other hand, was taken after the system was installed and shows very little variation in pressure during a 24-hr. period. These two charts tell the story.

Wash and Change Houses*

The value of change houses is not properly appreciated by the miners themselves, if the extent to which the houses are used is an indication. A great many men do not change their clothes on coming to the surface after a shift, but go to their destination in the clothes in which they have been working. The proper appreciation of the necessity of changing wet clothes, especially when the weather is severe, is a matter on which the miners need education. Several mine operators have erected commodious and well-equipped change houses only to have their proper use disregarded and the fixtures broken. The advantage to be gained by a wash and a change to clean dry clothes after work is a real one that makes for health and lessens exposure, but many, if not most, of the miners seemingly have not realized this, even where opportunity has been offered. The disregard shown by employees of companies that have erected change houses has probably influenced other operators to refrain from erecting or equipping similar buildings.

The value of change houses is a subject that can be handled in a general campaign of education among the miners; the necessity for such a campaign is great, and it is to be hoped that it will be undertaken in the near future. Mines that have no change houses should erect them. A plain wooden building, properly heated and having running water for wash purposes, is all that is essential. Shower baths, individual lockers, and otherwise elaborate structures, although of undoubted benefit where there are sufficient reasons for erecting them, are naturally not to be looked for where only a few men are working; but a warm shelter for changing clothes should be available, even at small mines. The exposure resulting from men going home a considerable distance in wet clothes in cold weather undoubtedly furthers disease, particularly tuberculosis, and to induce appreciation of this by proper education of the miners is one of the things that will help to reduce the prevalence of pulmonary tuberculosis in several mining districts.

The Bureau of Mines has published Technical Paper 116, "Miners' Wash and Change Houses," covering the subject of hygiene considerations and giving plans and descriptions of change-house equipments and an excellent bibliography.

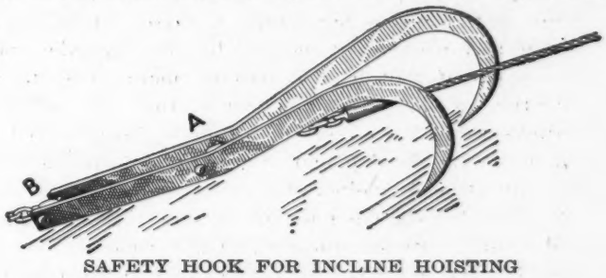
*Excerpt from Technical Paper 105, Bureau of Mines, "Pulmonary Disease Among Miners in the Joplin District, Missouri."

Runaway Tubs or Hutches

Under the title "Runaway Tubs," a correspondent of the *Iron and Coal Trade Review*, London, describes a method devised to prevent dropping of men being hoisted on an incline in case the hoisting rope breaks, as follows:

The risk run in lowering men down an incline or dook in hutches or tubs has again been brought to notice in the recent accident at Norton colliery, whereby two men were killed and nine injured. The speedy conveying of workmen to the various points underground has been rendered necessary by present conditions, and the practice has grown of taking a large number of workmen in one journey, thereby increasing the risk of injury.

To overcome or reduce to a minimum this risk the writer devised an apparatus—a sketch of which is shown herewith—to hold the train of hutches or tubs in case the rope should break when coming up or going down an incline. The apparatus consists principally of two flat bars of steel bent, spread and connected as in the sketch. The haulage rope is attached at A and the connection to the train of tubs is made



SAFETY HOOK FOR INCLINE HOISTING

at B. The sketch shows the connections clearly and indicates the spread of the bars necessary to clear the rope and pulleys and still be inside the rails. In a model the design was tested on all inclines up to 60°, and in every case, whether in lowering or raising, the hutches or tubs were held.

The writer would not recommend its use on roadways where short light rails are laid, but only on permanent laid roads. There is no fear of the hooks catching unless the rope breaks; so long as a strain is on the rope it is not possible for them to act. The appliance also prevents a sudden jerk being put on the rope through tubs catching when going down and then clearing; under such conditions the hooks would catch.

Resetting a Derailed Shovel

An old steam-shovel engineer, according to *Brick and Clay Record*, makes the following suggestion: If the front wheels are off of the track, fill the dipper with rock or other heavy material, loosen up one jack arm and swing the dipper over this side. This will raise the other side of the shovel. Put a number of men on the up-side jack and tighten it down as hard as possible. Swing dipper over high-side and screw down low-side jack. Continue this operation until the shovel is off the center bearing. If there is a key in the kingbolt, the trucks will be raised off the track.

If the rear trucks are derailed, lay blocks in the usual manner in order to assist the wheels to climb on the rails. If this is unsuccessful, drop the dipper and boost by means of the thrusting engines.

Details of Milling and Smelting

Baggaley Patent for Utilizing Heat of Molten Slag

U. S. Pat. 1,160,817, granted on Nov. 16, 1915, to the late Ralph Baggaley, of Pittsburgh, covers a method of utilizing the heat of molten slag by passing water, air, or other fluid to be heated, around a series of small receptacles into which the molten slag is poured. The apparatus suggested consists of a multiplicity of open-top conical slag "tubes" depending within a passage or container, and means for periodically inverting the device to discharge the cooled slag. One form of apparatus resembles a Walker casting machine, the lower part of the mold containing a water space connected with a central boiler and drum. A variety of constructions is shown for heating either air or water, all dependent upon passing the fluid around the depending tubes of solidifying slag and the periodic inversion of the slag tubes for the purpose of emptying.

This is a subject that has attracted the attention of many metallurgists, but owing to local conditions has seldom been worked out successfully. Mr. Baggaley stated in his patent that he had devoted many years to this investigation and had ascertained that the following features were either essential to, or at least seemed desirable in, the development of a successful apparatus for the utilization of molten slag:

1. The slag must not be able to shrink away from actual contact with its container at any time.
2. The slag must be delivered in such small units that it will congeal promptly.
3. A great number of such small units must be provided in order to obtain sufficient heating surface.
4. The volume of water to be heated must bear a proper proportion to the volume of slag which does the heating.
5. As the slag units congeal, cool and shrink, they should be free to fall by gravity so as to remain in actual contact with the container on all sides.
6. The slag-supply ladle should contain the same quantity of slag as the power-generator units, so that the slag may be poured quickly, without measuring.
7. The whole vessel should be well protected on all sides to prevent heat radiation.
8. As the slag tonnage is very large, the spent slag should be handled by machinery.
9. The feed water should be preheated to approximately 210° F., in order to secure proper efficiency in the apparatus.
10. The apparatus must be absolutely safe at all times against explosions or other accidents.
11. The free and complete discharge of the spent slag by mechanical means is important.
12. The possibility of water leaks into the molten slag must be absolutely guarded against to prevent disastrous explosions.
13. The apparatus must be durable in ordinary use.
14. The apparatus should not be more expensive to build than good boilers of the same capacity.
15. When the spent slag, after being discharged from the generator units, is used for the purpose of preheating the feed water, care should be exercised to prevent excessive sulphur in the feed water. This can be neutralized by any of the well-known chemical methods, or the hot spent slag may be delivered into a submerged container in the feed-water tank in a manner to prevent the slag from coming into actual contact with the feed water.
16. In order to provide sufficient heating surface, as well as to simplify the discharge of the spent slag, it is essential that the small slag units be located in one or more holding vessels which are separate and distinct from the boiler.
17. In order to maintain a supply of dry steam a dome or storage boiler should be provided, distinct from the water-storage boiler.

Handling Low-Grade Matte at Anyox, B. C.

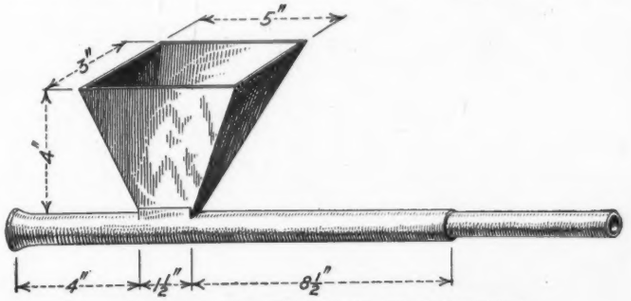
The rehandling of low-grade matte is a problem at many smelting works. At the Anyox plant of the Granby Consolidated Mining, Smelting and Power Co., in British Columbia, the management has eliminated much hand labor by applying the back-haul scraper principle to this problem. The low-grade matte is poured into long beds, and upon solidification the edges are broken with powder so as to give the special digging bucket or scraper a start. A donkey engine operates the digging bucket, which is pulled along on the bed, digs into the matte and is then hauled up the incline shown in the accompanying view. The bucket dumps into the railroad cars, and the matte is transported by a high line to storage bins and redrawn for the furnace charge.

DRAG SCRAPER DIGGING AND LOADING MATTE AT ANYOX

Originally the converting of the first matte was done directly, but it was later found that it would be more economical to raise the grade by reconcentration. When resmelting was first started, the matte was stored in beds and dug up with pick and shovel. This was expensive, and it became necessary to find some mechanical way of doing it. The amount of hand labor and the cost of loading the matte have been much reduced. With six men, including the hoist man, as much as 600 tons of matte has been loaded in a day by the new arrangement. The objectionable feature of this method of loading is that the proportion of fines made is too great. This could be reduced by making shorter beds and thicker layers of matte, but the ground space at Anyox does not permit this improvement.

Cement Gun for Pointing Up Boiler Settings

A gun for squirting cement into the cracks of brick boiler settings is described by Harry Roebuck in *Power*, Dec. 7. From a length of brass tubing about 1 in. diameter was sawed a piece 14 in. long. Four inches from the end an opening 7/8 in. wide and 1½ in. long was cut with a sharp chisel, the tube being slipped on an iron rod held in the vise, while cutting. The cut was made along the center of the opening, and the metal was



CEMENT GUN FOR BOILER SETTINGS

bent out straight along the two sides. To the two sides was attached a hopper, 4 in. deep and 3 by 5 in. at the top, made of tin. The short end of the tube was given a flare of about a quarter of an inch, and a short piece of loosely fitting broom handle for a plunger completed the gun.

The plunger should not be too snug a fit, and the sand should be screened through a fine screen, or trouble will be experienced from sticking of the plunger. By rinsing the apparatus in a bucket of water each time before loading, the cement will flow more freely.

Making Babbitt Castings

A recent article on babbitt casting, by J. H. Van Deventer, in the *American Machinist*, embodies the following points.

If babbitt is heated to over 900° F. the chances of getting a scaly job are very good. The high limit is 850° F., which is too high to be tested with the finger, but can be judged from a pine stick, being the point at which such a stick when thrust into the metal hesitates whether to burn or not and finally decides to do so. This is too hot for pouring, unless the shell to be run is less than 1/8 in. thick. For ordinary work the metal is right to pour when it will char the pine stick but not produce flames.

There are three kinds of hand ladles for pouring babbitt—the good kind, the bad and the indifferent. A good ladle is one with a lip designed to pour a heavy *solid* stream. That is, a ladle with a rounded lip, preferably with a dross dam, is best.

When remelting scrap, boil green hickory wood with the metal to remove the dross. Beware of blowing out a cast-iron shell with compressed air before babbitting. Air lines contain water, and this won't mix with babbitt. Hand bellows are safer. A large casting too heavy to lift can be dried by burning gasoline in it. Use sal ammoniac in the melting pot if you want clear metal.

Remember that a thin section will cool quicker than a thick one and must be poured hotter. Remember that powdered rosin sprinkled and rubbed on a damp job will prevent explosions. Smoking a mandrel with lamp black will do if rosin paper or clay wash is not available. A heavy cord dipped in clay wash will act as core for an oil groove.

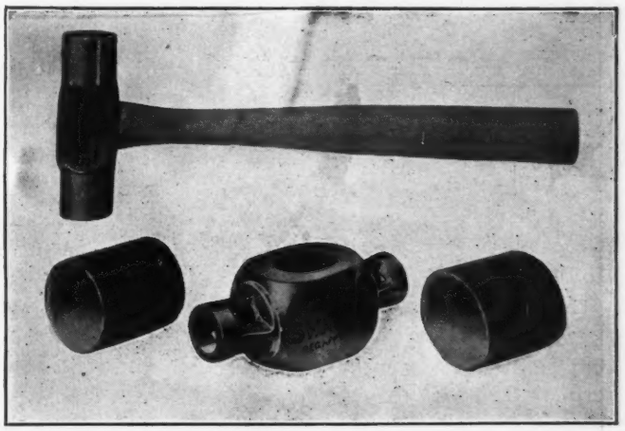
Slow cooling makes bearing metal coarse-grained. Open up the box as soon as the babbitt is cold. Dirt and dust rise to the highest point on the mold. Risers and a high pouring gate will get them outside of the bearing.

If you must pour a bearing cold, use a mixture that contains plenty of antimony. It won't shrink as much as other mixtures will. Remember that air is lighter than babbitt and vent at the highest point. You cannot depend on air getting out where the babbitt goes in. Give it a private exit. Overheated metal, lack of proper vent and slow pouring are back of most spoiled bearings. Hence, last and most important of all, *pour quickly*.

Soft-Metal Hammer

The soft-metal hammer shown is intended not only for general machine-shop use, but also for sheet-metal work, garages and repair work of various kinds.

The body of the hammer head is made of tough bronze that is practically indestructible, and it will stand all

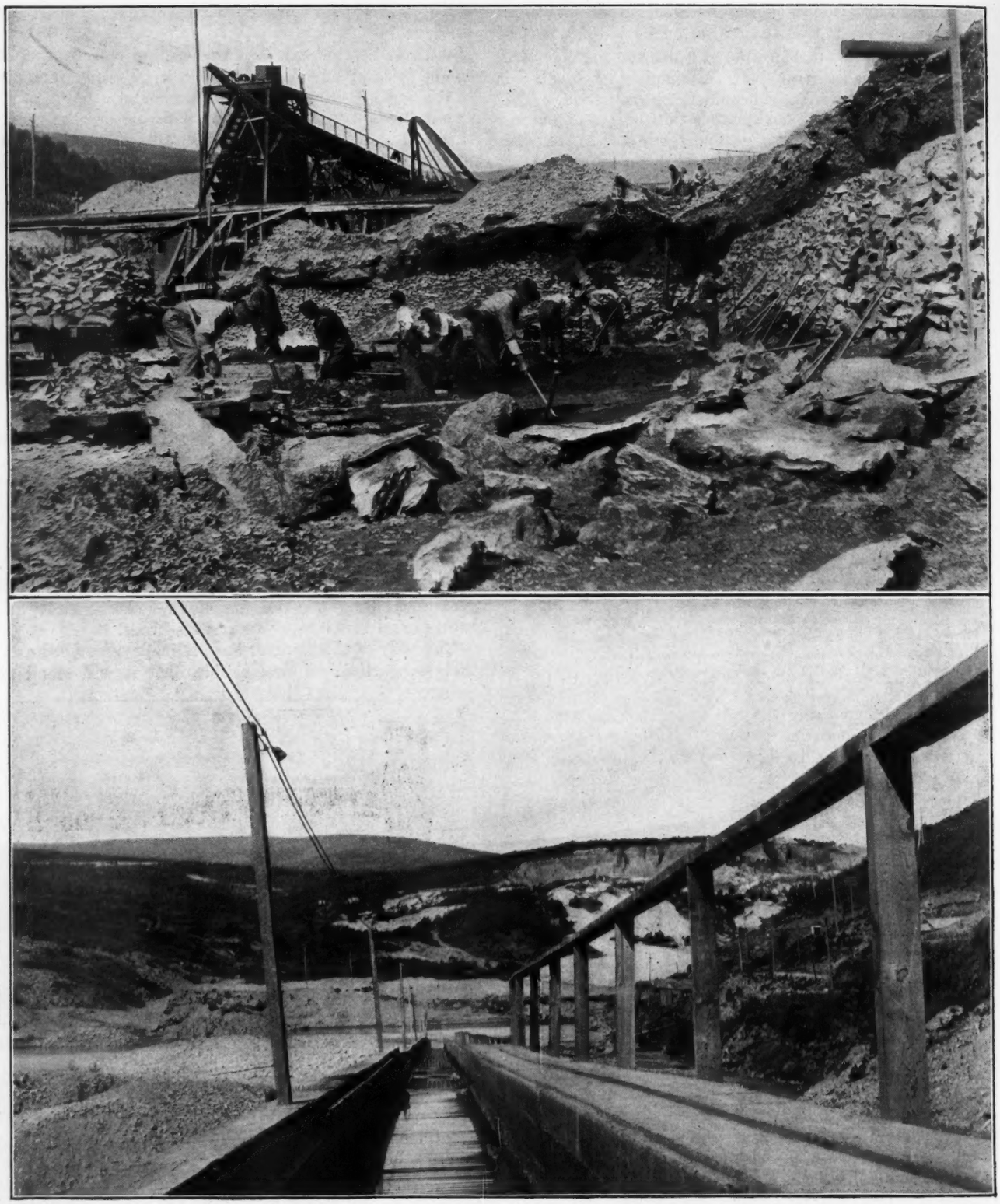


SOFT-METAL HAMMER HEAD AND MAILING TUBE MOLDS

the reheating necessary to melt out the old metal preparatory to renewal. It is so made that short sections of paper mailing tubes may be used as molds for the soft metal. The lower picture shows two of these sections and a bronze head.

The hammers are furnished with handles and soft ends in 1-, 2-, 4- and 6-lb. sizes. They are recent products of the Bauth Manufacturing Co., 901 Gerke Building, Cincinnati, Ohio.—*American Machinist.*

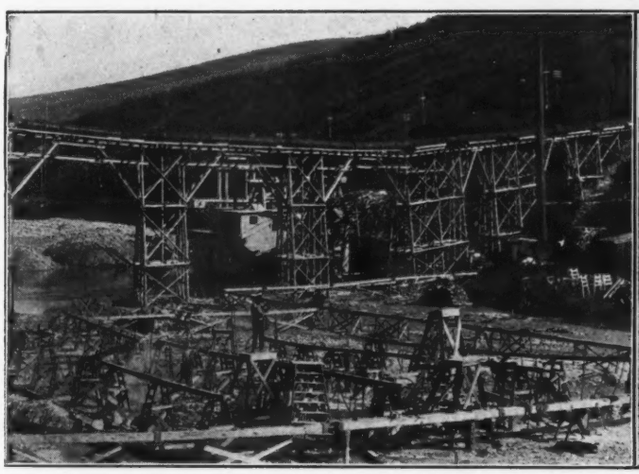
Yukon Gold Co.'s Operations



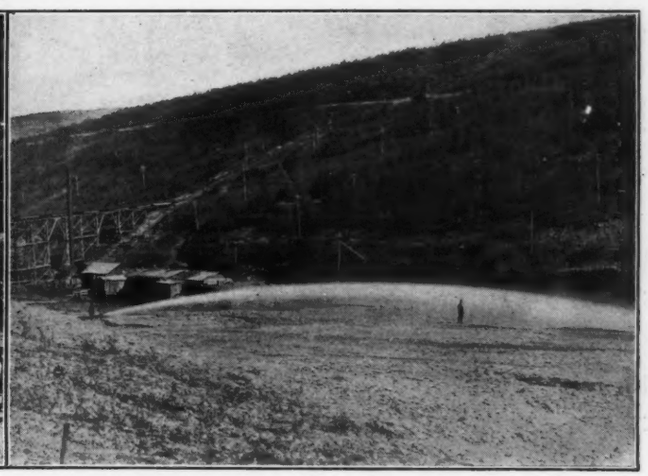
CLEANING BEDROCK AT ELEVATOR NO. 3. PREVIOUS TO THE APPLICATION OF DREDGING THE BONANZA CREEK GRAVELS WERE HANDLED BY HYDRAULICKING IN CONNECTION WITH MECHANICAL ELEVATORS. LOWER VIEW SHOWS THE UPPER SLUICE OF ELEVATOR NO. 3

MECHANICAL ELEVATORS USED BY YUKON GOLD CO. IN THE EARLIER OPERATIONS ON BONANZA CREEK

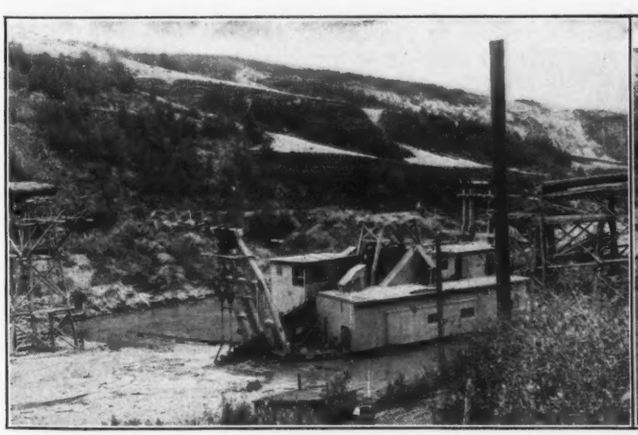
Hydraulicking in connection with portable mechanical elevators was abandoned on Bonanza Creek when it was found that the dredges could be built strong enough to dig the bedrock and handle the large boulders or slabs that may be noted in the foreground of the above picture. The derrick shown in the center background was used to facilitate the removal of boulders and bedrock slabs preparatory to cleaning bedrock. The dredges now dig this bedrock and operate more cheaply than the elevator method. At the right is shown a nearer view of one of the mechanical elevators. These elevators were mounted in a portable steel frame, fitted with flanged wheels. The excess water is elevated from the pit to the sluice by a 12-in. centrifugal pump driven by 100-hp. motor. There was also a 10-in. auxiliary pump used when a rush of water was encountered



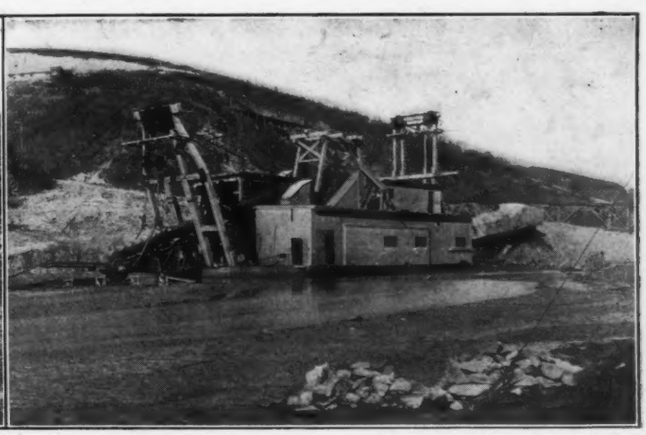
NO. 5 DREDGE APPROACHING THE BONANZA INVERTED SIPHON



HYDRAULICKING ON BONANZA CREEK ABOVE THE SIPHON



NO. 5 DREDGE PASSING THROUGH THE SIPHON



NO. 5 DREDGE ABOVE THE RESTORED SIPHON

Library Service Bureau

The Library Board of the United Engineering Society, in order to bring the usefulness and facilities of the engineering library closer to the individual members of the profession, has inaugurated a service bureau which will maintain a staff of expert searchers and translators for researches and translations for those who are at such a distance from New York that they are unable to avail themselves of the facilities of the library.

The service bureau has also arranged to keep those who may desire it posted on the current publications of any engineering subjects that they may specify. In this connection, reference cards giving the title, author and exact citation of all published articles on the subject are mailed to the subscriber. Then, if copies or translations are desired, they will be furnished on application, at previously stipulated prices.

The prices charged for this work are kept down to the merely self-supporting basis, because the United Engineering Society does not carry on any work of a commercial character.

The engineering library has over 60,000 volumes on technical subjects and receives currently over 1,000 engineering and scientific periodicals. In addition, access is had to the New York Public Library and the library of the Chemists' Club, so that researches can be covered on almost any engineering subject.

Requests for information and rates should be addressed to the Library of the United Engineering Society, 29 West 39th St., New York City. E. Gybbon Spilsbury is chairman of the Library Service Committee, which is making every effort to bring this service to the attention of the profession at large, for whom it is designed and to whom it is conceived to be of great potential benefit.

The Clifton-Morenci Strike

The Lake Superior strike of 1913 introduced many features of labor warfare that were humorous in their very outrageousness. The Clifton-Morenci strike is even more picturesque. One of the accompanying illustrations shows the concentration camp. What? Of strikers, or strike-breakers? No. Simply of miners who would like to go to work and are not permitted to do so by the labor leaders, aided and abetted by the county and state officers.

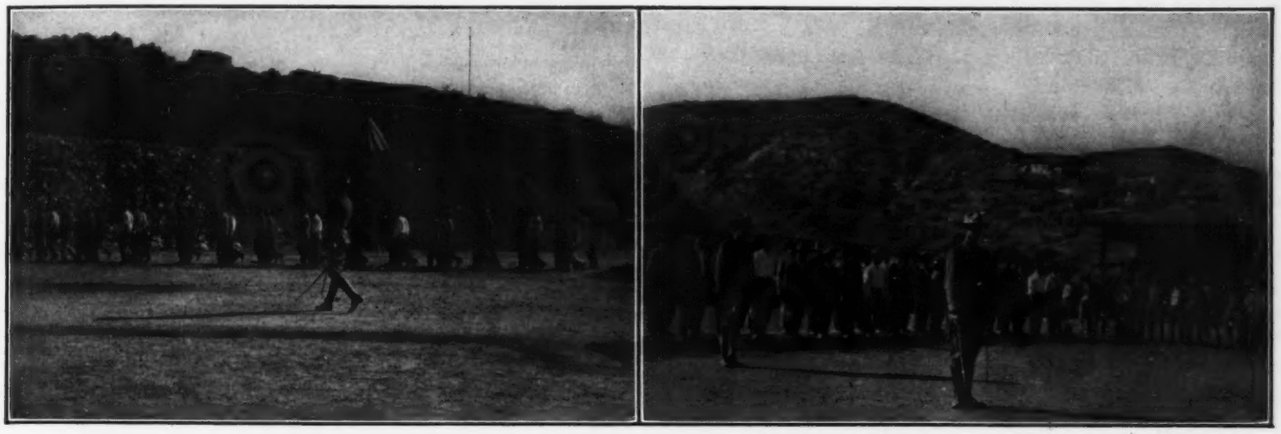
STRIKERS IN THE CLIFTON-MORENCI DISTRICT OF ARIZONA LISTENING TO A WESTERN FEDERATION SPEECH IN FRONT OF THE MORENCI HOTEL

It's hard to get news from Clifton and Morenci. The correspondent, or indeed anybody else who enters town, has first to pass an inspection something like what an entry into Russia used to entail. If the sheriff and the labor leaders pronounce him O. K. he gets 24 hr. in which to transact his business and depart. However, if during his visit he turns out to be a *persona non grata,* he is apt to be caused to depart on shank's mare and barefoot. If *non gratissima,* tin cans are tied to his person, which also is appropriately placarded according to the views of the labor leaders and officers of the law.

It looks as if democratic government had ceased to exist in this part of Arizona. Irvin Cobb or Sam Blythe ought to go there as war correspondents to tell the country about the death of liberty in a part of the United States. However, if we were their editors, we should not

AWAITING ARRIVAL OF PRESIDENT MOYER OF WESTERN FEDERATION OF MINERS

STRIKERS AT MORENCI ON THE DAY THE MANAGERS LEFT THE DISTRICT



STRIKERS IN CLIFTON-MORENCI DISTRICT BEING DRILLED BY LIEUT. LEE OF ARIZONA NATIONAL GUARD

THE REFUGEE COLONY AT DUNCAN, ARIZ., ABOUT 40 MI. SOUTH OF CLIFTON

"VIVA LA WESTERN FEDERATION OF MINERS!" STRIKERS PARADING UNDER THIS BANNER AT METCALF, ARIZ.
The group at the right has just "induced" the clerks in the Arizona Copper Co.'s store to join the union. The head bookkeeper is holding the drum to show his conversion

venture to send them there unless we could get von Mackensen to help.

We hear, however, that the property of the mining companies is being taken care of fairly well. The sheriff is attending to that, and nobly is doing his duty. He is hiring a corps of deputies to guard the property. He hires them among the strikers. Thus as deputies they are guarding what as strikers they are threatening. The mining companies are paying the wages. Herein we have a truly humorous situation. As a financial arrangement it is something like that of the cat and rat farm.

Copper in Germany

The following interesting article by Gilbert Hirsch, its Berlin correspondent, recently appeared in the New York *Evening Post* (copyright, New York Evening Post Co., 1915), by whose courtesy we reprint it, only slightly condensed. It was dated Oct. 21. The comments that are introduced are our own.

There is no copper famine in Germany; there is not going to be one. England, to be sure, has decreed that no American copper shall go to Germany, and no American copper goes there. Some copper did get through by way of Holland and Scandinavia in September of last year; but England put an end to that by bringing pressure to bear on Holland and the Scandinavian countries. This interfered with the business of Scandinavia and Holland, prevented Italy from getting some of the copper which she needed to arm herself for participation in the war, cut down the output of the American copper mines and caused a boom in the German copper industry. As to the ultimate object—a shortage in the German ammunition supply—it does not exist and is not in prospect.

The cutting off, to be sure, of the 35,000,000 lb. of copper which Germany was accustomed to get from America every month has had an appreciable effect. In times of peace Germany, the second largest copper manufacturing country in the world, makes articles containing 225,000 tons of copper. This year it makes none of these articles, devoting its entire copper supply to military purposes. No copper money is minted, and the resulting shortage in small change is already making itself visible in the requests posted in many retail stores, that customers give the exact change in payment. You hear of how carefully the copper from used ammunition is being saved; of the rounding up of all the available copper in every position captured from the enemy. You see women walking through the streets carrying between them copper kettles or gramophone horns to sell to the authorities. If you are a householder, you are invited to fill out long detailed forms describing everything you have made out of copper or brass and specifying whether or not the artistic or historical value of each piece is double the value of the raw material contained in it; for the German government has determined not to melt down anything that might be considered a work of art.

Precautions Against Shortage

From all these symptoms one might conclude, if not acquainted with German psychology, that Germany is face to face with a real copper famine. But all these measures, like the use of the bread-card, and the prospective milk card, are precautions against a shortage and not the confession of one.

At the outbreak of the war Germany had more than 75,000 tons of raw copper—much of it American copper—on hand in factories and warehouses. Measures were at once taken to increase the ouput from the German mines. In normal times they produce some 50,000 tons yearly.[1] Since the war began many of them have increased their production more than 50%. But the chief recourse of the military, in case of pressing need, will be the old copper. It is impossible to estimate exactly how much there is in a country which, like Germany, has been mining copper for a thousand years. Yet no doubt the German lust for statistics will be satisfied here as it is everywhere else. A few days ago the householders sent in to the proper municipal centers their blank forms all *regelmässig* filled out, and the necessary computations will be very quickly made.

The government has announced that it will begin buying up these articles, if it finds such a course necessary, by Nov. 16. It is not believed that these compulsory sales will actually take place in November, nor in six months from November, for the amount of copper which the government has already received through voluntary sales is said to be enormous. The price paid is an extremely good one—1.7 marks per kg.—that is, about 37c. for 2⅕ lb. The German government which is, just now, poor in so many things, is, thanks to the unexpected success of its war loans, very rich in money. And its liberal payments for copper within the past year have enabled many a poor family to live for months on the proceeds of its own kitchen utensils.

One hears the hope frequently expressed on the part of housewives, and with a great deal of fervor, that these voluntary sales will make a later confiscation unnecessary. I have heard a woman discuss, with tears in her eyes, the possible loss of a copper and brass wash-tub which had cost her no end of time and trouble to keep clean, just as she might discuss the possible loss of a troublesome but dearly loved son on the field of battle. There is, in the German woman's love of her copper things, an intensity that is peculiarly racial. One feels as if, in some mysterious way, the Germans must belong to those races, like the ancient Persians and Egyptians, among whom copper, and not gold, was the royal metal.

As the German production of copper wares for home consumption has amounted in recent years to an average of 125,000 tons per annum, there is no question that the supply on hand is enormous. Not all of it, of course, is in private possession. There are hundreds of thousands of tons in street-railway wiring. And when, a couple of days ago, I put the copper problem to one of the persons most intimately concerned with the stretching of all Germany's resources, the answer was:

"Our roofs. Take a city like Dresden, where so many of the roofs are of copper. If we get hard up, we just have to go down there and take the roofs off a few *Rathhäuser* (municipal buildings) and we are saved." And there are many roofs in Belgium and in northern France which can also be used, if need be, for the same purpose.

And if the worst comes to the worst, a substitute can be used. To those who are familiar with copper and its peculiar qualities, this sounds like an impossibility. But

[1]The most authoritative statistics credit Germany with a copper production of 25,000 metric tons in 1913, which was larger than the average for several years immediately preceding. The official report of the Mansfeld mines, the principal producer, showed no increase in 1914.—Editor.

the German chemists and physicists during this war have obeyed the order "invent" in much the same spirit in which the German soldiers have obeyed the order "fire" or "charge." When a substitute for a thing has to be invented, it is invented. There have been invented since the outbreak of the war substitutes for rubber, for eggs, for wool, for meat, for leather, for string, for coal, for gas. In Germany the same word is used to indicate a substitute for a thing and a reserve regiment for the army—*Ersatz*. It is said that the substitute for copper has been found in a soft steel.

That it is not expected that a substitute for copper will be needed for a long time to come, however, is sufficiently proved by the fact that the copper mines of Germany are not being worked nearly as intensively as they might be, if the situation were considered serious. I visited the other day the Rammelsberg mine in the Harz Mountains, which belongs to the state. I found that it has had its working force materially reduced since the outbreak of the war and that there are only one and a half shifts a day, of eight hours each. The fact that in spite of this it now produces considerably more than before the war is due to a concentrating on the production of copper and cutting down materially on the mining of lead, of which, in peace times, four thousand tons was annually produced from ores taken from this mine.[2]

Romance of an Old Mine

The story of this oldest copper mine in Germany is full of romance. History has it that the mine was discovered and worked by the Franks in those distant days before the Germans understood the art of fashioning copper. But the tradition is that it was one of the knights of Emperor Otto First—the Ritter Ramm—whose horse laid bare some ore with a beat of its hoof. Traditions die hard in the Harz Mountains. The very price fixed by Emperor Otto for the carting of a wagonload of ore—nine pfennigs—holds to-day. And the miners of these days are said to be the direct descendants of the miners then. They cling to their peculiar superstitions, to their bizarre costume, to their custom of assembling in church every Monday morning before going into the mine, to pray for their safety while in the bowels of the earth, and to their ancient form of salutation *Glückauf!* which is a pious hope that you may return safely to the surface of the earth.

In the market place of Goslar, half a mile from the mine, and itself a thousand years old, is a great bell, on which the citizens used to beat whenever there was danger of attack, to call the miners out of the depths of the Rammelsberg mine to help in the defense. The bell is no longer rung. But the same obligation to give up their work at a moment's notice to help in the national defense is still on the men who work in this mine. Nor does the fact that this mine belongs to the state—a three-sevenths share belongs to the province of Brunswick, the remaining four-sevenths to Prussia—nor that these men are doing work essential to the defense of Germany make any difference. When the war broke out, every miner of the specified age, who could pass the physical examination, had to go. And only the fact that this mine happened, at the time, to be employing a large number of men past fighting age, saved it from serious embarrassment. I have been told that the miners are well thought of in the field. Most of them are assigned to pioneer regiments; but I have heard of one who—no doubt for variety's sake—joined the flying corps.

A German Mining Town

To speak of Goslar as a mining town might give a wrong impression, since it reminds one of a scene from "Meistersänger" or "Faust" rather than of the grimy streets of Butte or the abandoned shacks of Virginia City. But the city has lived for a thousand years from the steady flow of metal from this one mine; its history has largely consisted of battles between rival nobles for the possession of the mine; its fine old monasteries and churches were due less to a particularly religious spirit in the town itself than to the desire of the clergy to make quite sure of receiving their full tithe from the mine, by being on the spot. In the Middle Ages it was one of the most strongly fortified towns in Germany, completely walled, and defended by 180 towers (of which three are still standing) which could not have been built but for the wealth that the Rammelsberg mine brought into the coffers of the city. And the defense was carried on by nobles who had made the city their residence in order to seize some of the precious metals from the mine and—in a literal sense—make money out of them. For the mine still turns out as much as 75 kilos of gold and a hundred times that quantity of silver every year.[3]

The story of this German mining town is a sufficient answer to those Americans who claim that it is our "commercialism" that keeps us from being as "picturesque" as Europe. Goslar has attained its present distinguished appearance through the fact that it has been doggedly commercial for ten centuries. The very Kaiserhaus on the hill above the town, of which the Germans are so proud, would not have been built there had it not been for the mine, whose riches were the determining factor with Henry II (despite his sobriquet, "the Saintly") in fixing on Goslar as the capital of the "Holy Roman Empire" in the eleventh century.

I went into the mine itself, 450 yd. below the surface. No horses are used in the interior to carry out the ore—and no boys under 19, the German law fixing this age as the minimum for underground employment being strictly observed even in war time. [Some lines here have been cut out by the censor.] We went through miles of passages roofed by ore containing lead which looked like flashes of silver, copper which looked like streaks of gold, and zinc which looked like deposits of copper, past men boring into the sheer rock with compressed-air drills, past elevator shafts and emergency shafts.

As we were down below the very center of the mountain, one of the men from another mine who accompanied us, asked the manager of the mine whether he believed in the *Wünschelrute* (the divining rods by which, according to an old belief, it is supposed that one can tell where the rich deposits are). He himself, he said, was

[2]The Rammelsberg mine, a famous and interesting ore deposit, has never been aught than an insignificant producer of copper in modern times.—Editor.

[3]The author is here describing the mining customs of the Harz, an extensive and picturesque district, rather than of the Rammelsberg mine alone. That mine is in the lower Harz. Goslar and Oker are the nearest towns. In the upper Harz the best-known town is Clausthal, where there are numerous mines, the ore being taken to Lautenthal and Langelsheim in the lower Harz for smelting. All of these are classic names in mining and metallurgy, but like that of Freiberg in the Erzgebirge, their industrial importance waned many years ago.—Editor.

absolutely convinced that it has properties that are as good as magical. But the manager laughed.

"I believe only in my Bible," he said.

"Your Bible?" I asked.

"I mean the American *Mining Journal,*" he said, smiling. "We all read it religiously. For years the rates cited in it, rather than the prices listed in the German journals, have been the basis of the German mining trade. Since the outbreak of the war, the English have kept all other American mining products from us."

The shoot of ore in this mine is wider than anywhere else in the world, is extremely rich in copper, in some cases yielding as much as 22% metal. But it is a comparatively small mine, employing, together with the Oker smelteries, with which it is affiliated, only about 2,000 men. This is far less than the Clausthal mine, in the Upper Harz, to say nothing of the mine at Mansfeld, the largest copper mine in Germany, and the one at Eisleben, in Halle, which also produces an enormous quantity of zinc and employs 10,000 men.

When we came up to the surface the "Mr. Mountain Inspector"[4] (as the manager of a mine is quaintly called), after showing me the various safety devices insisted upon by the German government, took me into a building where there was an apparatus which had been insisted upon—more or less indirectly—by the British government. It was a plant, just completed, for the manufacture of liquid air, which, as I learned, is being substituted for dynamite in all the principal mines of Germany, now that the supply of Chile saltpeter has been cut off.

Liquid Air for Explosive

The use of liquid air as an explosive has been known ever since the famous Professor Linde took out the first patent in 1895. It was used in the building of the Simplon Tunnel, and has been tried in a number of countries, notably France. But until very recently it was regarded as still in the experimental stage. Immediately upon the outbreak of the war it was put into practical operation throughout the German mining industry. The results have proved so successful that it is now certain that it will continue to be used in place of dynamite even after the war.

In the first place it is peculiarly safe. You can take a cartridge—as they call the little black mouselike bags—put it into the bucket of liquid air which, literally, steams with cold, until the cartridge has soaked up 90 gr. of it, and then, with the assurance that you are dealing with an explosive more than half again as powerful as the ordinary charge of dynamite, you can put it down and step on it, and the only result is a fizz as of so much steam. I saw five of these cartridges jammed with a stick into the holes drilled in the rock, just as if they had been so many wet rags. And then I saw the men running like mad, when the electric current was turned on and the pieces of rock began to fly.

The cheapness is another advantage. Over against 20 pfennigs, the approximate cost of a dynamite cartridge, one cartridge saturated with liquid air costs, at this Rammelsberg mine, only 12 pfennigs. And where it is made in larger quantities, the cost is even less. A whole new industry is in the process of development in Germany to manufacture and handle liquid air; and the principal firm, the Marsit Corporation, declares the cost of liquid air to be just one-half that of dynamite.[5]

[4]Berginspektor = mine inspector. The literal translation is more humorous than accurate, whatever be the derivation of the term.—Editor.

[5]The use of liquid air was described in recent issues of "Stahl und Eisen."—Editor.

Revision of Mining Laws

The meeting of the Mining and Metallurgical Society of America in collaboration with the American Institute of Mining Engineers, the American Mining Congress, the Idaho Mining Association, the Montana Society of Engineers, the California Metal Producers' Association, the Spokane Mining Men's Club, the Nevada Mine Operators' Association and the Colorado Scientific Society, together with representatives from several chambers of commerce and many operating mines, was well attended. Many delegates came from distant states, including South Dakota, Montana, Idaho, Oregon, California, Utah, Arizona and Colorado. Organizations unable to be represented communicated resolutions in approval of the purpose of the meeting.

The first session was called to order by W. R. Ingalls, president of the Mining and Metallurgical Society of America, who briefly stated the purpose of the meeting. The idea was to impress upon Congress the earnest wish of the mining industry that the archaic mining laws of the United States be revised; that a commission be promptly authorized for this purpose. In this program all of the mining societies and the mining press of the country had united. While the present meeting was being held under the auspices of the Mining and Metallurgical Society of America, the other national organizations and the several state societies had been invited to collaborate and were doing so; also the chambers of commerce in the mining towns of the public-land states; moreover, through the medium of the Bureau of Mines, every mine operator of the United States had been invited to participate.

The rules for the conducting of the meeting were then read and approved, and the appointment of the following committees was made: Credentials—J. F. Callbreath, George Collins and George C. Stone. Rules—J. Parke Channing, S. W. Mudd and Frank A. Ross. Resolutions—H. V. Winchell of Minneapolis, Minn.; E. B. Kirby, of St. Louis., Mo.; Hennen Jennings, of Washington, D. C.; Walter Douglas, of Bisbee, Ariz., and John Kirchen, of Tonopah, Nev.

The chair was then taken by Carl Scholz, president of the American Mining Congress, who introduced the first speaker, E. B. Kirby, of St. Louis. Mr. Kirby made a general presentation of the bad situation that has come to pass under the mining law of 1872, which for 43 years has stood unrevised, although the knowledge of ore deposits has increased enormously during that time.

Following Mr. Kirby, Hon. Franklin Lane, Secretary of the Interior, made some graceful remarks extolling the importance of the mining industry, welcoming the mining men to Washington, and in concluding stated that he would anticipate his forthcoming annual report by informing the meeting that he recommended a revision of the mining laws. "The old code," he said, "is so elaborate and complicated that the best of brains cannot tell what the law is. The truth seems to be that between mining engineers and mining lawyers the rules of the game

have been refined into obscurity; and if Congress were to say to the President that he might select three men familiar with mining laws and miners' difficulties to suggest a new mining code to Congress, it would, I believe, be giving in earnest a new freedom to the mining industry."

The next address was by Hon. E. T. Taylor, member of Congress from Colorado, who read the bill that he had introduced in the House of Representatives on Dec. 6 (H. R. 18) and explained its provisions. Mr. Taylor remarked that the total representation in Congress from the public-land states was but a small proportion of the membership; that the representation from the Eastern, Southern and Middle States is not much interested in such a question as mining law revision; that he is the only member of the committee on mines and mining who is from a mining state. Congress, he said, is becoming more and more averse to the creation of commissions. In his bill he had provided for an unpaid commission, considering that the House of Representatives would be more likely to agree to that than to a paid commission, and he for his part being hopeful that five men sufficiently patriotic to give their services to the Government would be found. The exemption of coal, oil, phosphate and potash lands from the scope of his bill was introduced at the request of the Administration, which has a well-defined program respecting them.

Mr. Taylor made a very excellent impression, both on account of his sincerity of purpose and his thorough knowledge of his subject. For the purpose of discussion the bill introduced in the Senate by Senator Smoot was also read.

A lively debate respecting the merits of the two bills ensued, especially with regard to the composition of the proposed commission and the having a general revision or having a revision with certain classes of mineral lands excluded. The general opinion appeared to be that the revision ought to be of the broadest character and that the commission should consist of mining men rather than mining lawyers.

F. F. Sharpless, secretary of the Mining and Metallurgical Society of America, introduced the resolutions that were to be offered by that society. By agreement of the meeting, other resolutions were read by title and referred directly to the committee on resolutions. That committee was also authorized to frame and introduce resolutions at a subsequent session.

The second session was opened at 2:30 p.m. with William L. Saunders, president of the American Institute of Mining Engineers, in the chair. The first speaker was the Hon. Reed Smoot, United States Senator from Utah, who made an impassioned address, voicing the demand of the mining industry that the archaic mining laws be revised. He explained the provisions of the bill that he had introduced in the Senate and announced that on that day it had been reported favorably by the committee on mines and mining and had been put at the head of the Senate calendar.

Following Senator Smoot, an address upon the need of revising the mining laws in the light of modern knowledge of ore deposits was made by Dr. George Otis Smith, director of the United States Geological Survey. J. Parke Channing then gave a talk, illustrated by lantern slides, upon the conditions existing in the Miami district of Arizona, illustrating a case where the law of the apex is utterly inapplicable and was abolished for the district by the common consent of the mining companies.

Horace V. Winchell then offered, in behalf of the committee on resolutions, the following that had been agreed upon by that committee:

1. The mining law of the United States should be revised, not piecemeal, but thoroughly, so as to coördinate and harmonize its various provisions.

2. For the purpose of giving the fullest consideration to the needs of every branch of the mining industry and every section of the country as affected by the mineral-land laws of the United States, it is desirable that a Government commission be created by Act of Congress, whose duty it shall be to investigate by every proper means the questions and interests here referred to, and to make recommendations as to a basis for the proposed mining-law revision.

3. That in order to represent the classes of men whose interests will be affected, the proposed commission should consist of five members: One representing the legal profession, one representing the Department of the Interior, and three men actively interested and experienced in mining and the acquisition and handling of mineral lands.

4. That this commission shall be selected and appointed by the President of the United States.

5. That this conference believes that the services of such a commission are deserving of compensation, as well as reimbursement for all necessary expenses, but is more concerned with the actual establishment of the commission and its character than with the question of emolument, and will gladly see the work done through an honorary commission if Congress deems it advisable.

6. That this conference expresses itself in favor of the creation of a permanent committee on mining-law revision, such committee to consist of five members from the Mining and Metallurgical Society of America, five from the American Institute of Mining Engineers and five from the American Mining Congress, and be appointed by these organizations. Such committee to have the power to select its own chairman and secretary and to add to its membership not to exceed 10 additional mining men or others interested in the subject for which the committee is created. The work of this committee shall be to further the interests of the mining industry through congressional action in accordance with the resolutions adopted at this conference; and its joint report shall be presented to each of the societies formally represented in its make-up.

There was a lively discussion upon the recommendation that one member of the proposed commission should be a representative of the Department of the Interior. Ravenel Macbeth, speaking for the Idaho State Mining Association, was violently opposed to this, saying that Idaho did not want any bureaucratic interference with the mining industry; that it had already had enough of it. Mr. Macbeth was supported by E. Percy Smith, of Wallace, Idaho. The other side was taken by J. Parke Channing, of New York, and by E. B. Kirby, of Missouri. Frank A. Ross, of Spokane, Wash., supported the views expressed by Mr. Channing and Mr. Kirby. When put to vote, the recommendation of the committee on resolutions was upheld by a large majority.

In the evening session the chair was taken by W. R. Ingalls, president of the Mining and Metallurgical Society of America. The first speaker was Horace V. Winchell, who delivered an exhaustive and scholarly address on the subject of ore deposits and the inapplicability of the extralateral law to many of them. He pointed out, moreover, many other failures of the law of 1872. Hon. Charles S. Thomas, United States Senator from Colorado, then made a brief but pertinent address from the standpoint of the mining lawyer, but one who is thoroughly in accord with the purpose sought by this meeting. In conclusion Senator Walsh of Montana delivered a carefully prepared speech in support of the need of revision of the mining laws on even broader grounds than the mischief of the law of the apex and the prerequisite of discoveries where honest discoveries cannot be made.

Editorials

Revision of the Mining Laws

The convention, or conference, of mining men that was held in Washington on Dec. 16 under the auspices of the Mining and Metallurgical Society of America was a noteworthy event, especially for its exhibition that all of the mining organizations of the country—both national and state—could and would unite for a common purpose; next for the unanimity of opinion respecting the particular object of the meeting that was displayed; and finally for the effectiveness that the meeting promises to have. The hall in which the several sessions were held was so commodious that the attendance did not appear to be so large as it really was. Yet it was really remarkable that so many mining men came to it from distant parts of the country. As the reports are carried home the after-effects will become even more important than the immediate ones. The debates in the Washington meeting were less spirited than they would have been if there were less unanimity of opinion.

It is known now, beyond peradventure, that the men engaged in the mining industry in the public-land states want the mining laws revised and codified as a whole; that they want this to be done by Congress upon recommendations by a competent commission after thorough study of the subject. These points were embodied in resolutions offered by the Mining and Metallurgical Society of America. The American Institute of Mining Engineers had previously adopted the same resolutions. The American Mining Congress had formally expressed itself to similar effect. The resolutions had also been officially approved by several state mining societies.

It was made clear, moreover, that the mining men of the United States in great majority want abolition of the law of the apex and of the law making discovery a prerequisite to location. Many of the state mining societies had also followed the Mining and Metallurgical Society in those particulars, but the council of the latter had decided not to press its own action in those matters, regarding it as being incompatible with the major purpose; that is, the securing of a commission to revise and codify the mining laws as a whole. It was not deemed fitting to ask for such a commission and say in advance what it was expected to do. The expressions of opinion on these subjects that have previously been made will surely have great weight, however, in the minds of any commission that may be appointed.

The bills that have already been introduced in Congress by Senator Smoot of Utah (Senate, 52) and Mr. Taylor, of Colorado (H. R. 18), crystallize the issue. Both of these bills provide for the preparation of a tentative code of laws governing mining lands and rights by a commission to be appointed by the President, but they differ in important particulars. Senator Smoot's bill provides for a paid commission of three members, "two of whom shall be lawyers of large experience in the practice of mining law and one a mining engineer who shall have had practical experience in the operation of mines," and the scope of the commission is unrestricted. Mr. Taylor's bill provides for an unpaid commission of five members, "who shall be selected because of their recognized experience in, or knowledge of, the mining industry and mining law;" and the laws relating to coal, oil, phosphate and potash lands are excluded from their consideration.

Both Senator Smoot and Mr. Taylor said frankly that certain of their provisions were framed out of considerations of policy and did not necessarily exemplify their personal views. Therefore criticism of these points may be made without any fear of hurting the feelings of their sponsors. Indeed, Senator Smoot declared from the platform that his chief desire was to have revision, and that no controversy over the way of going about it should be permitted to defeat the purpose. He was of the opinion, however, that the Government of the United States should not make it impossible for any man to serve upon such a commission owing to inability to give the time to do so; nor should it ask of any citizen such a favor as the gift of his time. Mr. Taylor, on the other hand, is of the opinion that the House of Representatives will not agree to a paid commission. However, both his bill and Senator Smoot's provide for $25,000 for expenses in the aggregate. Senator Smoot would have the commission draw $18,000 in salaries, leaving $7,000 for traveling, clerical and printing expenses, etc., while Mr. Taylor would have $25,000 available for those purposes.

With regard to the composition of the commission, Senator Smoot provides for a membership of three, two of them mining lawyers, which he said was in conformity with the ideas of Senator Walsh, chairman of the Senate's Committee on Mines and Mining, while Mr. Taylor would simply have five mining men.

These subjects and others were debated in the Washington meeting. The committee on resolutions made the recommendations that the commission should consist of five members, of whom one should be a mining lawyer, one a representative of the Department of the Interior and three men experienced in mining. As to remuneration the committee was of the opinion that whatever Congress could agree upon would be satisfactory to the mining industry, or at least that difference in ideas over that matter should not stand in the way of action. This report was adopted by a large majority, although there was dissent by the Idaho delegates respecting representation of the Department of the Interior. The action of the convention in these matters was broad-minded and rational, whatever might be the individual views.

On one matter neither the committee on resolutions nor the convention as a whole expressed itself so clearly as it might have done, namely, the question of the scope of the commission. It had previously been pointed out in discussion that the exclusion of coal lands and phosphate lands would create uncertainty and dispute with respect to cases where coal and phosphate rock occur in

connection with metalliferous minerals, while moreover, it is illogical—and probably not intended—to exclude potash deposits and not to exclude soda deposits. The convention confined itself to the opinion that the mining laws should be revised in whole, wherefore, it is to be deduced that the review by the commission should comprise all sorts of mineral deposits—iron, copper, coal, oil, alkali and everything—but this opinion was not clearly defined.

Speaking for itself, the *Journal* is of the opinion that Mr. Taylor's bill is a better bill than Senator Smoot's. It provides for a commission of five mining men. If the men engaged in the mining industry should speak out without any considerations of politics, diplomacy and the getting of what they want by giving up something different, we think they would say that this is purely a mining question. Let it be attended to by mining men. They can employ lawyers for the legal advice that is necessary. With the commission recommended by Mr. Taylor, we should probably get a better piece of work than by the commission recommended by Senator Smoot. The most objectionable part of Mr. Taylor's bill is the exclusion of coal, phosphate, oil and potash lands from general mining-law revision. Such exclusion is in deference to the Administration, which has another program with regard to those lands. If such exclusion there must be, the language that effects it ought to be carefully considered. We know of gold placer deposits occurring above coal seams, of gold occurring with alunite (a potash mineral), and of mines that are worked both for metals and for apatite (a phosphate mineral). One of the greatest mining litigations in this country, one that was longer drawn out than any of the apex cases and was more costly than most of them—we refer to the Franklin Furnace litigation in New Jersey—arose from the deeding of one kind of mineral to one man and another kind to another man, both occurring in the same vein. The Administration and Congress ought to be exceedingly careful about excluding certain kinds of mineral deposits from a general revision of the laws.

Villa Gives Up the Fight

Villa's admission that he is beaten and his proposal to seek refuge in the United States is the most hopeful thing for Mexico that has happened in many years. Heretofore as soon as any patriot has succeeded in casting out the usurper, one of his followers has risen to repeat the process. So it was with Villa, but instead of carrying on the thing indefinitely, he gives in at last and lets his country have a chance for peace. In so doing, he will make a greater name for himself in history than he would as a bandit. Already he gets such recognition as this from the *Evening Post:*

> Villa's acknowledgment that the game is up is formal recognition of a fact that has been patent for some months. It marks the end of an epoch and the beginning of another which will be signalized with due pomp when Carranza enters Mexico City and sets to work at the reconstruction of Mexico with the good will of the nations. For the moment our interest attaches to the flitting from the contemporary stage of one of its most picturesque characters. "Pancho" Villa, the outlaw, who came within striking distance of the Presidency of Mexico, the bandit who developed into a military genius, represented in his own person the raw capacities of the Mexican people for good and evil. He was the peon to whom the policies of Diaz denied the opportunity for developing into a contented and prosperous citizen of his country. It has been a romantic career. Yuan Shi-Kai, who has won an emperor's crown, set out from the high position of governor of one of China's greatest provinces, and has traversed the interval in 15 years. If we measure the distance from Villa's starting point to where he stood at the height of his power, the record is no less impressive. Nor does the picturesque record suffer from the fact that the outlaw Villa rose to fame on the crest of a great cause, that he will go down in history as one of the avengers of Francisco Madero and a vindicator of the cause of Mexican democracy.

In this there is a good deal of truth, although we have some doubts about the "cause of Mexican democracy." However, the great thing is the prospect that warfare in worn-out Mexico, is ended, in spite of the unregeneration of Zapata and the silly plotting of Felix Diaz. Let us hope that Don Venustiano will be reasonable in his decrees and will not tax the miners more than they can bear or compel the bankers to redeem their current notes with gold before they have any gold to do it with. American mining men are already hurrying back to Mexico, and without any doubt they will soon be active in their operations.

Tungsten and Molybdenum

One of the most spectacular advances in commodity prices occasioned by the war has been in tungsten, both metal and ore. This has been due to the extraordinary demand for tungsten steel—an essential constituent in making high-speed tool steel. The manufacture of immense quantities of military material has required greatly increased quantities of tool steel, and consequently corresponding quantities of tungsten; hence the advance in price for it.

Before the war high-speed tool steel was worth about 70c. per lb., tungsten about 60c. per lb. and tungsten ore about $6 per unit. At present high-speed tool steel fetches about $3 per lb., tungsten about $5 per lb. and tungsten ore about $50 per unit. Even at the enhanced prices supplies are scarce.

The fabulous price for tungsten ore has stimulated prospecting for it throughout North America and South America. This ore is not known to occur in large deposits. The annual production of concentrated ore in the United States previous to the war was only about 1,400 tons. However, this ore has now become so valuable that the discovery of a deposit that affords a single carload is the finding of a fortune. A ton of ore assaying 60% tungsten trioxide—the standard commercial grade—at $50 per unit is worth $3,000; a carload of 40 tons would be $120,000. So precious is this ore that the assay offices are being scoured for specimens. Brokers do not sneer at trade in one-pound lots. The purchasing agent of the Crucible Steel Co. is very grateful if somebody can give him 100 lb.

A contributory factor in the production of this situation was the utter stupidity of the British authorities. They fought the advance from the beginning. When they were offered some tungsten ore, they came back with a lower bid—trying to dicker in what was not a dickering market—and naturally failed to get what they wanted. Then they practically commandeered the supply of tungsten ore in the British Empire, appointing official brokers and fixing a price of 55s. per unit, or about $800 per 2,000 lb. of 60% ore if exchange be figured at 4.86. Previous to the war that would have been regarded as a fine price, but the producer in Australia, Burma, Malaya and elsewhere does not think very much

of it when the same grade of ore is fetching $3,000 or so per ton in America. Patriotism does not go quite so far as that. His policy appears to be to restrict production until such time as the authorities may raise the price, which he believes they will have to do. In so forecasting the future he is a better economist, we are inclined to think than is the bureaucrat in London.

In the meanwhile there is relief immediately at hand if the manufacturers of tool steel would only avail themselves of it. We mean the substitution of molybdenum steel for tungsten steel. It is well known that molybdenum steel has excellent qualities of more or less the same character as tungsten steel. There is an extensive literature on this subject to which the tool-steel maker may refer. It is indeed claimed by some authorities that molybdenum steel is superior in certain respects to tungsten steel. The chronic reluctance of manufacturers to get out of the beaten tracks is offered as an explanation of their blindness to the merits of molybdenum steel. But even if it were not preferable with tungsten at 60c. per lb., it might be when that metal is more than eight times as high.

The point is that molybdenum ore and the products thereof are now a drug in the market. While the tungsten mines are being worked at the limit of their capacity, the molybdenum mines have had to be closed, and the smelters of molybdenum ore are carrying large unsold stocks of the products that probably they would be glad to sell at cost. The manufacturers of tool steel and the British authorities are recommended to give some attention to this situation.

⁂

According to an evidently inspired article in one of the financial papers, the Alaska Gold Mines Co. is going to stop increasing the tonnage sent to the mill at the expense of grade of the ore and for a while will make tonnage secondary to a grading of the ore. By February it is hoped to have the mill running on $1.50 ore. The delivery of the ore to the mill will be increased later as rapidly as the development of the mine will permit it. The experience of the Alaska Gold Mines Co. is another example of the principle that the opening of a mine so as easily to furnish 10,000 tons of ore daily is more of a job than the building of a mill to treat it.

BY THE WAY

An unusual consignment of gold from China was received recently at the Assay Office in New York City, says the New York *Times,* consisting of a single bar of fine gold worth about $600 in a bamboo covering. It came from the agency of the Guaranty Trust Co. in Shanghai and was credited to that institution. The hollow of a length of bamboo was utilized as a natural safety carrier for the 4-in. bar, one end being sealed by the joint and the other with wax. The valuable package came by registered mail. There have been numerous shipments of gold from China to this country this year, but most of them have been directed to the San Francisco Mint.

⁂

Roland was green but willing. His resolve to "follow mining" led him to Colorado, where he obtained a job as assistant to a deputy mineral surveyor. The first day out he was informed that the work immediately in hand was to "tie" certain indicated tunnels and assessment pits to a mineral-monument base line. Whereupon he gazed mournfully up toward the summit of Republican Mountain and then toward the village of Silver Plume, meanwhile fumbling a ball of plumb-bob twine that he fished out of the kit, remarking, "Then I better hurry down to the store, hadn't I?" "What for?" inquired his employer. "Well," rejoined Roland, "it will take a damned sight more string than I can find in this bag."

⁂

The safety-first movement has reached the stage of education through slogans, says the Boston *News Bureau.* Safety-first literature teems with them. The walls of workshops are covered with them. Among the following, drawn from the Inland Steel Co. and other sources, employers might select an assortment:

Keep out of debt and danger. Both are alluring, yet poor friends to make.

Peace, prosperity and good health depend on the selection and proper preparation of normal food material.

The difference between a wise man and a fool is the fool's mistakes never teach him anything.

The thinker will not drink. The drinker cannot think.

Any fool can take a chance. It takes brains to be careful.

It takes only a moment of carelessness to cause a lifetime of suffering.

When hurry interferes with safety, cut out the hurry.

⁂

Two powerful American trench-digging machines, says the *Scientific American,* have been in operation for some time at the Canadian camps, where men who will ultimately be sent to the fighting front are being trained. These men are already thoroughly acquainted with life in the trenches, but the trenches have been dug for them by the American machinery referred to, thus relieving them of the hard shovel-work. This innovation was originated by General Sam Hughes, commandant of the Canadian militia, and has proved to be quite successful. At one of the camps two of these machines dug seven miles of trench, 5½ ft. deep, with a 2-ft. bottom, in 10 days. They are readily moved about under their own power and dig trenches of any reasonable depth or width with straight or sloping sides.

⁂

Many contradictory tales have been heard concerning the unobtrusive woman who, in 1885, discovered the principle of oil flotation, in Denver. Since her invention has attained fame, technical men have sought to establish her identity and to give her proper recognition. Recently such efforts—especially those of Howard C. Parmelee, secretary of the Colorado Scientific Society—have brought tangible returns, and it is now established that this lady was not a spinster school teacher, as commonly stated, but the wife of a practicing physician. Her full married name was Carrie Jane Everson, and she occasionally undertook nursing cases in her husband's practice. Since the discovery that she was the wife of a scientific man, it has been assumed that the doctor was largely responsible for the flotation invention, but a telegram received in Denver recently from the son, John L. Everson, of San Anselmo, Calif., reads: "Mother alone invented flotation process. Father assisted in securing patents." While the application of this process has been world-wide, Colorado is coming in for such pronounced benefits from it that there exists a local desire to perpetuate the name of Mrs. Everson.

PERSONALS

J. R. Finlay has returned from Missouri.

B. B. Thayer has returned from Montana.

The offices of Philipp Brothers are now at No. 29 Broadway, New York.

Kirby Thomas, of New York, is examining mines in the Casa Grande district in Arizona.

L. L. Middlecamp superintendent of the Ellamar Mining Co., Alaska, is in the States for the holidays.

H. A. Guess has returned to New York after an extended visit to the Braden and Chiquicamata mines in Chile.

Richard Roelofs, general manager Cresson mine, Cripple Creek, Colo., has returned there from Oatman, Arizona.

J. W. McKim, formerly of Salt Lake City, but for some years back in the Transvaal, has arrived in San Francisco.

W. L. Cumings, of the Bethlehem Steel Co., has returned to South Bethlehem after spending four months in Chile and Peru.

E. A. Cappelen-Smith has been elected a director of the Chile Copper Co. and the Chile Exploration Co. He has gone to Chile.

W. R. Van Evera consulting engineer for the Hill Mines Co. on the Cuyuna Range, has returned to Virginia, Minn., after a visit to New York.

S. D. Bridge, who for the past 26 years has been interested in mining in Mexico, returned to Monterey Dec. 11 after an absence of over two years.

J. H. Plummer, president of the Dominion Steel Corporation, who has had a severe attack of illness, has recovered sufficiently to attend to business.

J. Norman Sherer, of Bellefonte, Penn., has been made superintendent of the blast furnaces of the Reading Iron Co., Reading, succeeding Albert Broden.

L. W. Trumbull is now in the oil fields of southern Illinois. He will be at the Raleigh, Washington, D. C., during the meeting of the Geological Society of America.

Alfred B. Iles, of the Alaska Copper Corporation and Iles Power, Water and Light Co., is in the States on his vacation. He is located at Strelna on the Copper River Ry. in Alaska.

Charles A. Sulzer has taken over the lease of the Alaska Industrial Co. at Sulzer and in future will handle the mine personally. This copper mine has been a continuous producer for 14 years.

Charles Andrews, a well known prospector has returned to Winnipeg from the Gold Lake district where he made important discoveries and staked a number of claims for the Harris syndicate of Winnipeg.

Col. Thomas Cantley, president of the Nova Scotia Steel and Coal Co., who has been prominent in connection with the work of the Canadian Shell Committee, will shortly leave for England and will probably make a six months' stay.

Frederick Peiter has severed his connection as coke oven engineer with the Gas Machinery Co., Cleveland, Ohio. For the past three years he has been engaged in the designing and development of the company's top burner regenerative coke oven.

Among the western mining men attending the conference on revision of the mining laws at Washington on Dec. 16 were George A. Collins, of Denver; John Kirchen, of Tonopah; E. Percy Smith and Ravenel Macbeth of Wallace, Idaho, and S. W. Mudd, of Los Angeles.

Lorne A. Campbell has been appointed Minister of Mines in the newly formed administration of British Columbia. He is one of the leading business men of the interior of the province and has had a wide practical experience in connection with mining and power development.

Henry M. Payne, left London on Dec. 11, on his way to Petrograd, where he expected to arrive about Dec. 20. He will attend further sittings of the Committee of Technical Experts to the Lena-Lenskoie controversy, and expects to return to London and sail for America in January.

Charles E. Duncan, who has been superintendent of the old Cambria works at Johnstown, Penn., has been appointed general superintendent of the Donner Steel Co. and has entered upon his duties at Buffalo. He went to Johnstown from the Carnegie Steel Co. and previously had been superintendent of the Algoma Steel Co. plant at Sault Ste. Marie.

Secretary Lane has ordered the transfer of R. B. Marshall, chief geographer of the Geological Survey, to the position of superintendent of the National Parks, effective at once, and to continue during the balance of the fiscal year. Sledge Tatum has been designated acting chief geographer, and he will continue to serve as geographer in charge of the Rocky Mountain Division.

W. L. Smith, manager of the Mountain King Mining Co., Valdez, Alaska, went to the property with a companion late in October to inspect workings. His companion returned a few days afterward and Smith was expected to follow in five days. On Nov. 17, three weeks later, nothing had been heard of him and searching parties are now looking for him.

OBITUARY

Frank Howard Bailie died in Pittsburgh, Penn., Dec. 14 aged 44 years. He was born in Freeport, Penn., but spent most of his life in Pittsburgh. He had been for 27 years past connected with the H. K. Porter Co., of which concern he was assistant sales manager at the time of his death. He leaves a widow and one son.

Sidney E. Bennett died in Denver, Colo., Dec. 11, aged 33 years. He was graduated from Colorado College and in 1903 established offices in Denver. He was born in Brookfield, Mo., but went to Colorado when a young man. He was widely known among mining men in that state and throughout the Rocky Mountain region, in which he traveled extensively. For several years he represented the Hill Publishing Co. in Colorado.

Abraham Overholt Tinstman died at Turtle Creek, Penn., Dec. 14, aged 81 years. Born and brought up at Broad Ford, Penn., he was one of the first to enter into the coke business in the Connellsville region 50 years ago. He was a partner with Henry Frick in starting in the coke business at Broad Ford and Mt. Pleasant, and later he organized the Connellsville Coal and Iron Co. He continued in the coke business until a few years ago when he retired.

Richard Henry Lee died at Lebanon, Penn., Dec. 8, aged 56 years. He was born in Pennsylvania and graduated from Lehigh University. Soon afterward his father put him in charge of the cold-blast charcoal furnaces of the Logan Iron and Steel Co., at Burnham, Penn., where he remained for six years. Later he was in charge of blast furnaces for the Colorado Fuel and Iron Co., the Tennessee Coal, Iron and Railroad Co., the Alabama Steel and Iron Co., the Lackawanna Steel Co., and the Shenandoah Iron Co. For three years past he had been superintendent of Lebanon furnaces of the Pennsylvania Steel Co., and consulting engineer for Dunbar Furnace of the American Manganese Manufacturing Co. He was a close student of blast-furnace operations and a successful experimenter, solving many problems in the management of the blast furnace. He was noted for his kindness, especially to younger men, and made many warm friends among his associates. He was a member of the American Institute of Mining Engineers, the American Iron and Steel Institute and the Engineers' Society of Western Pennsylvania. He contributed many valuable papers to the technical press and to the "Transactions" of the Institute of Mining Engineers. He leaves a widow and one son.

SOCIETIES

Teknik Club meeting, Denver, Dec. 14, was addressed by J. M. Simpson on "The Calcination of Zinc Carbonate," and by H. B. Barnes on "Excessive Costs of Caring for Mental Defectives."

Society of Chemical Industry—The regular meeting of the New York section was a joint meeting with the Chemists' Club held at Rumford Hall, New York. The evening was devoted to a lecture on "The Production of Radium from Carnotite," by Dr. Charles L. Parsons, of the Bureau of Mines, Washington, in which he gave an account of the plant which has been erected in Denver, for this work.

Colorado School of Mines has begun the publication of a monthly press bulletin, containing items of interest to the readers of mining publications. During the president's visit to San Francisco he arranged for the purchase of numerous new pieces of equipment for the school's ore-testing plant, including a 10-ton Oliver continuous filter. A Flowers viscosimeter for testing flotation oils has also been purchased.

Geological Society of America—The annual meeting of this society will be held jointly with the Association of American Geographers in Washington, Dec. 28-Jan. 1. Dr. T. W.

Vaughan, of the Geological Survey, is chairman of the committee on arrrangements. A. H. Brooks, F. L. Ransome and P. S. Smith are chairman of subcommittees under Dr. Vaughan. This committee has gone to a considerable amount of work to arrange for a successful meeting.

University of Idaho—The School of Mines will offer during the months of January and February, 1916, a short course for prospectors, miners and millmen. The subjects treated will include prospecting, mineralogy, mining geology, mining, metallurgy, ore dressing and concentration, and milling. There are no fees in connection with any of these courses, and instruction is free. The work is laid out especially for mature men who desire to make the most of their time during this brief period.

Iron and Steel Institute—A circular from the London office says that the Council announces that the annual meeting has been fixed to take place on May 4 and 5, and the autumn meeting on Sept. 21 and 22, 1916. Both meetings will be held at the rooms of the Institution of Civil Engineers, Great George St., Westminster, London. Sir William Beardmore will be inducted into the chair as the new President of the Institute, in succession to Dr. Adolphe Greiner. The Bessemer Gold Medal for 1916 will be presented to F. W. Harbord, honorary consulting metallurgist to the Ministry of Munitions. It has been decided not to hold an annual dinner next year.

Colorado Scientific Society held its regular monthly meeting Dec. 4. The attendance and interest in the society is better this fall and winter than it has been for several years past. Prof. Herman Fleck, of the chemistry department, Colorado School of Mines, read a paper on "Molybdenum," this being the second in a series of four lectures on rare metals to be delivered by him this season. He covered the technology and development of this metal. The series will be eventually published as a bulletin. This was the meeting at which nominations for officers were made and the following were duly nominated for 1916: President, Howard C. Parmelee; first vice-president, Thomas B. Stearns; second vice-president, Frank E. Shepard; treasurer, John W. Richards; secretary, Arthur J. Hoskin. S. A. Ionides and Victor G. Hills were nominated on the executive committee.

University of Illinois—To extend and strengthen the field of its graduate work in engineering, the University of Illinois has since 1907 maintained 10 research fellowships in the Engineering Experiment Station. These fellowships, for each of which there is an annual stipend of $500, are open to graduates of approved American and foreign universities and technical schools. Appointments to these fellowships are made and must be accepted for two consecutive collegiate years, at the expiration of which period, if all requirements have been met, the master's degree will be granted. Not more than half of the time of the research fellows is required in connection with the work of the department to which they are assigned, the remainder of the time being available for graduate study. Nominations to fellowships, accompanied by assignments to special departments of the Engineering Experiment Station, are made from applications received by the director of the Station each year not later than Feb. 1. These nominations are made within the month of February by the station staff, subject to the approval of the faculty of the Graduate School and the president of the University. Appointments are made in March, and they take effect the first day of the following September. Vacancies may be filled by similar nominations and appointments at other times. Nominations to these fellowships are based upon the character, scholastic attainments, and promise of success in the principal line of study or research to which the candidate proposes to devote himself. Preference is given those applicants who have had some practical engineering experience following their undergraduate work. The Engineering Experiment Station, an organization within the College of Engineering, was established in 1903 for the purpose of carrying on investigations in the various branches of engineering, and for the study of problems of importance to engineers and to the manufacturing and industrial interests of the State. Research work may be undertaken in architecture, architectural engineering, chemistry, civil engineering, electrical engineering, mechanical engineering, mining engineering, municipal and sanitary engineering, physics, railway engineering, and in theoretical and applied mechanics. The work of the Station is closely related to that of the College of Engineering, and the heads of departments in the College constitute the administrative station Staff. Investigations are carried on by the members of the staff and other members of the instructional force of the College of Engineering, by special investigators employed by the Station, and by the Research Fellows. By action of the Board of Trustees on Mar. 9, 1915, four additional research fellowships were created in the Engineering Experiment Station, making 14 in all.

INDUSTRIAL NEWS

Among the orders recently booked by the National Transit Pump and Machine Co. is one for three of its new type of Diesel oil engines. These are to be installed in the Joplin zinc district and will be an innovation in prime movers in that field. The Flannery Zinc Co. of Sarcoxie, Mo., will use a 200-hp. Diesel oil engine to drive its mill. Another of 150 hp. is to be direct-connected to a Sullivan air compressor. A third engine and pump are to be used in dewatering its mines and will be the first Diesel engine pumping unit to be installed in the Joplin district. The pump barrels will be 30 ft. below the surface while engine and pump will be above ground, a new method of installation in which the National Transit people are the pioneers.

The Diamond Power Specialty Co., manufacturer of Diamond soot blowers to suit every type of boiler, has announced an interesting prize article contest for the four best articles submitted on the subject of mechanical soot blowers. One hundred dollars in gold will be distributed, divided as follows: First prize, $50; second, $25; third, $15; fourth, $10. The contest is open to all consulting and operating engineers and to engineers-in-charge. Articles must be written on one of the following subjects: (A) What the mechanical soot blower has done toward greater economy and efficiency in the power plant; (B) The mechanical soot blower versus the hand method; (C) Why I indorse the use of mechanical soot blowers; (D) Why I have changed my attitude in favor of mechanical soot blowers. Only one article will be accepted from each contestant. No article less than 1,000 words in length will be accepted and articles should not be more than 5,000 words in length. Articles must be in the hands of the Diamond Power Specialty Co., Detroit, on or before Mar. 1, 1916. Articles must be written in ink, or typewritten, on one side of an 8½x11-in. sheet, or near this size. The Diamond Power Specialty Co. reserves the right to use any of the manuscripts in any way it chooses. The first four prize-winning articles will be published. No article accepted for competition unless proper entry is made before the article is submitted. Articles should be sent rolled or flat, not folded. Entry blanks and further particulars may be had by addressing the Prize Article Contest Department, care of Diamond Power Specialty Co., Detroit, Mich. Names of the prize winners will be announced in this publication.

NEW PATENTS

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

ALLOY—Metal Alloy of Iron, Cobalt and Manganese. Richard H. Patch, Philadelphia, Penn. (U. S. No. 1,162,186; Nov. 30, 1915.)

ALLOY of Copper, Nickel, Vanadium, Spelter, Tin and Aluminum. Charles Ramsden Denton, Sheffield, England. (U. S. No. 1,162,226; Nov. 30, 1915.)

BLAST-FURNACE SLAGS—Improvements in the Utilization of Blast-Furnace Slag and in the Recovery of Product Therefrom. T. Twynam, Redcar, Yorks., Eng. (Brit. No. 20,258 of 1914.)

CONCENTRATORS—Head-Motion for Concentrators. John F. Isbell, Los Angeles, Calif., assignor to Orren Allen, Denver, Colo. (U. S. No. 1,163,345; Dec. 7, 1915.)

DRILL-ROD EXTRACTOR. William Schildwachter, Walworth, Neb. (U. S. No. 1,163,560; Dec. 7, 1915.)

DRILLS—Improvements in Power-Driven Rock Drills. M. Kellow, Penrhyndeudraeth, North Wales. (Brit. No. 11,564 of 1915.)

ELECTRIC FURNACE. Carl Hering, Philadelphia, Penn. (U. S. No. 1,162,773; Dec. 7, 1915.)

ELECTRIC FURNACE. James M. Lohr and Horace W. Gillett, Ithaca, N. Y. (U. S. Nos. 1,162,178 and 1,162,179; Nov. 30, 1915.)

FUEL—Powdered-Fuel Feeder. Walter L. Caven, Cincinnati, Ohio, assignor of one-half to Walter Macleod, Cincinnati, Ohio. (U. S. No. 1,162,221; Nov. 30, 1915.)

FURNACE—Ore Furnace. Howard F. Wierum, Upper Montclair, N. J. (U. S. No. 1,162,894; Dec. 7, 1915.)

HEAT-INSULATING MATERIAL. Clarence P. Byrnes, Sewickley, Penn. (U. S. No. 1,162,450; Nov. 30, 1915.)

HOISTING—Locking Device for Hoisting Apparatus. William Rutan, New York, N. Y., assignor to Gillis & Geoghegan, New York, N. Y., a Firm. (U. S. No. 1,163,176; Dec. 7, 1915.)

LEACHING—Process of Treating Metallic Ores. Axel Estelle, Hagen, Westphalia, Germany. (U. S. No. 1,162,150; Nov. 30, 1915.)

MAGNETIC SEPARATION—Improvements in Magnetic Separation. Stephan Bruck, Charlottenberg, Germany. (Brit. No. 20,551 of 1914.)

Editorial Correspondence

SAN FRANCISCO—Dec. 15

Modoc County Miners are showing a persistence that should be rewarded. The Sunshine and the Modoc mines in Highgrade district have laid in winter supplies and are determined to proceed with development and extraction of shipping ore during the winter. Several other companies are getting their affairs in shape to resume active operation next spring. The miner who has faith enough in his mine to lay in a supply of provisions and material to keep his property going through a winter in Modoc county, is entitled to large returns on the investment of money and energy. Besides the operation in Highgrade district there is very little mining being carried on in Modoc county. When the district was first opened up three or four years ago a boom was started which was not warranted and which gave the camp a black eye and discouraged a number of investors who otherwise would have been of value to the camp. But some men who were pioneers in Highgrade are sticking to it with determination.

Amador County Merchants are proposing a bond issue of $250,000 for good roads. The county is paying out from $20,000 to $25,000 a year on roads, and as this amount would be sufficient to meet the interest on the bond issue, and provide for sinking fund, the bond plan would provide the needed highways without increase of taxes. The matter was considered at a meeting of the merchants at Plymouth and the recomendation was made by a former chairman of the board of supervisors. All the merchants present indorsed the plan and it is believed that the bond issue will be voted upon early in 1916. The annual payroll of the mines and other industries in Amador County amounts to $1,250,000. The transportation facilities are chiefly confined to the Amador Central Ry. running between Ione and Martell. This road is not available to all parts of the county, and supplies for the mines must be taken in by way of Ione or Latrobe and wagon-hauled to the mines. In some cases motor trucks are used. But the roads are not in good order for either motor trucks or wagons. With a good highway from Jackson, Sutter Creek, Amador City, Dry Creek and Plymouth, thence to Sacramento the merchants claim their transportation costs could be reduced by moving of water-borne freight from Sacramento by motor trucks. The proposed road work would include 13 mi. to connect with the Sacramento County line at which point connection would be made with the road leaving Sacramento by the way of Slough House. At present there are 15 mi. of this road beyond Walsh station in Sacramento County that would have to be paved before the highway could be completed and ready for use through from Sacramento to Jackson. There is little doubt that Sacramento would do this necessary work as direct haulage from Sacramento to the mines would be an important feature, well worth the expenditure.

BUTTE—Dec. 16

Increased Activity in the Philipsburg District following recent rise in silver is reported. Prominent among developing companies are Mondamin, which during past season has expended for equipment and mining over $22,000. Among leasers, Courtney Bros., operating Coyle property in Hasmark, has successfully exploited silver-lead deposit from which they have made several shipments of pay ore. McLure Bros. operating Sunrise property at Henderson, has recommenced shipment of copper ores from that property. Various leasers on ground of Philipsburg Mining company at the Hobo, Trout and other claims, have shipped cars of ore running as high as 10% copper and others as high as 100 oz. silver. Johnson and Thomas who have a lease on Gold Reef in South Boulder district have installed a cyanide plant that is successfully treating gold ores from that property. Granite Bi-Metallic Consolidated Co. has inaugurated campaign of surface and underground prospecting to disclose any heretofore unknown orebodies. During the last year company's property has been a continuous producer and has shipped over 300 cars of ore of all classes.

DENVER—Dec. 17

Cripple Creek District's Production for December is estimated at 83,550 tons, making year's output 982,697 tons of a gross valuation of $16,135,164. This means an average monthly production of about $1,345,000, which closely tallies with December figure. The lowest production for the year was in January when it was $1,121,884: The highest was in March, $1,986,493. The greatest tonnage in a single month was 92,175 for October.

A Reduction in the Treatment Rates at the two big custom mills at Colorado City—the Portland and the Golden Cycle will be announced soon, it is said. This will lessen the nominal treatment charge on low-grade Cripple Creek ores by $1 per ton, the new rate being $2. Heretofore, milling companies have paid the freight which averages about 50c. per ton; but, under the new terms, the shipper will pay his own freight, so that the proposed change really means a saving to him of about 50c. per ton, while the treatment rate is really lowered only the same amount.

Boulder County's Mineral Statistics for 1915 have been estimated by the Boulder Commercial Association and announcement is made that tungsten leads, by far, in the output of minerals—viewed from the standpoint of value. It is believed the year's production of this kind of ore will be about 1,440 tons with a valuation of $1,687,300. This ore, therefore, would appear to have averaged more than $1,170 per ton. A "dicker" between a miner and a purchaser of this class of ore last week resulted in the closing of a sale of a small lot of high-grade stuff at $60 per unit.

Breckenridge Used to be Famous as a producer of handsome specimens of free gold. Many remarkable pockets were encountered in the early days but not much has been heard of such bodies for a good while. Interest in them has been revived by the recent opening of a bonanza in the Dunkin mine on Nigger Hill, where leasers took out 240 lb. of stuff said to average 80% fine gold beside much second-grade material worth about $1,000 per ton. The pocket will probably show a production of $40,000.

Idaho Springs Shows More Activity than for a decade past. This pretty little mountain city has, recently, been much advertised as a summer and health resort because of its splendid hot and cold springs that are claimed to possess radioactivity. Indications are, however, that mining will again become the leading industry. In the "silver days," this town was lively: With the termination of high prices for silver, there came a slump. Owing to numerous shady mining deals that had disgraced the district, it was difficult, for a long time, to secure the attention of investors to its mineral merits. With interest again centering in the mining industry in general and the near-elimination of questionable financial practices, this district should thrive. Already several projects of significance have been financed. The McClelland Tunnel, started as a crosscut drainage, transportation and development adit toward the Lamartine part of the county and driven in about 1½ miles, has been newly re-financed and operations are about to resume. The Bellevue-Hudson, American Sisters, Boulder Nest, St. James, Tabor, Jo Reynolds and Commodore Tunnel are among other old properties that promise to resume operations in the near future.

SALT LAKE CITY—Dec. 16

Salt Lake Stock and Mining Exchange during November traded in 1,335,668 shares of stock, valued at $349,693; an increase of $109,662 over October. During 11 months of the year there were sold 15,461,931 shares of stock valued at $3,388,875 as compared with 3,387,020 shares valued at $693,472 during 1914.

A Sulphuric-Acid Plant is to be built in Salt Lake valley by the American Smelting and Refining Co. in the near future. The initial capacity is expected to be 100 tons per day, which can be increased as desired. Fumes from the smelters will be utilized. This crystallizes plans which have been under consideration for several years and have included almost every form of smoke consumer and utilizer.

Zinc Shipments continue from the Lakeview mining district on Promontory Point near Ogden. During November, the Lakeview Mining Co. made net earnings of $31,000, from the shipment of 19 cars of zinc ore, including four cars by lessees. This ore averaged 32% zinc. The first work as done in March of this year, and shipments were begun in May, from which time the property has been self supporting, and on a dividend-paying basis. In December eight cars or about 400 tons had been shipped up to the time that the dividend was paid.

WALLACE, IDAHO—Dec. 18

The Mineral Production of Idaho for the year 1914 was $24,976,706, and of this $23,607,604, or about 95% came from the Cœur d'Alene district in Shoshone County. State Mine Inspector Robert N. Bell, who spent several weeks in this district last month, estimates that the production this year will exceed $30,000,000. The large increase implied in his estimate will come largely from Cœur d'Alene mines, probably in about the same proportion as production in 1914. The tonnage for 1915 will probably not show much if any increase, the large increase in value being due to the high prices of lead and spelter. Two of the largest producers, the Hercules and the Morning, were shut down several months during the present year, otherwise there would have been a great increase in tonnage also. The dividend record for Cœur d'Alene mines will be far in excess of any year in the history of the district. Last year the total dividends amounted to $6,042,752 and was the highest record. This year dividends have now been declared amounting to $8,952,429. These figures are from official sources with the exception of the Hercules, which is estimated. The final figures will be in excess of $9,000,000 and possibly $10,000,000. Dividends for December already paid and to be paid before the first of the year amount to $1,377,985. This forecasts a Merry Christmas to many stockholders scattered all over the country and to thousands who receive good wages and steady employment through the operations of the mines.

The Golden Chest, in what is commonly referred to as the gold belt of the Cœur d'Alene district, has been the center of much interest the past few weeks. Many years ago the mine produced considerable gold, but questionable management and litigation long since forced it into idleness. The property has been quite extensively developed and has a 20-stamp mill. The company owns 37 patented claims and valuable water rights. After passing through many legal entanglements, the property is now owned by Samuel Green of New York. Mr. Green was here last week and coincident with his coming also appeared several mining engineers and geologists, all apparently bent upon examining the Golden Chest. There has been more or less mystery about the coming of these experts which time alone will solve. However, one highly interesting fact has been disclosed in connection with this famous old gold mine. In the old days when mining methods were more crude and less attention was given to careful analysis of ores, particularly free gold, much difficulty was experienced in saving the gold in Golden Chest ore on account of the heavy gangue, which was recognized as an unusual substance accompanying the quartz, but which no one appears to have taken the trouble to analyze. It is now learned that this troublesome stuff was scheelite (tungsten) and that it is found in combination with the quartz throughout the Golden Chest vein. Much of it was left in the stopes by the early day miners, while many tons went into the creek as tailings from the mill. At that time tungsten was worth about $300 per ton, while now, thanks to the war, it is worth over $3,000 per ton. This has infused new life into the long abandoned proposition. While Mr. Green was here he started men retimbering and generally repairing the underground works and tungsten ore is now being sacked for shipment. In addition to the tungsten, it is the opinion of capable mining men that under modern nethods of mining and milling the Golden Chest may again come back as a gold producer.

BELLEVUE, IDAHO—Dec. 15

The Croesus Gold Mine has been taken over by a Spokane, Wash., group headed by Fred C. Robertson. Possession was given by Kilpatrick Bros., the owners, Dec. 1. This is the property purchased a year ago by Robert T. Tustin and associates, who contemporaneously with its purchase, also purchased the Old Vienna property. The bond was forfeited as to the Croesus, and the forfeit money abandoned, in favor of the Vienna property, on which property a large number of men have been working since early summer. The first car of ore from development, high-grade silver running as high as 1,500 oz. to the ton, is just now being loaded at Ketchum—the nearest railroad point.

The Old Red Elephant Mine, which was in early days one of the bonanza producers of the Bullion District, situated on the opposite side of the diorite flow whose eastern contract produced the famous Minnie Moore, Queen and other bonanzas in the '80s, struck the vein in the 2,600-ft. crosscut driven for the purpose. The pay streak was a few inches over 8 ft. wide—about one-third of the ore being first-class shipping, and the balance the regular grade of old Original Red Elephant mill rock. These ores average 70% lead and 130 oz. of silver. The Company celebrated the "melon" in Chicago last week, by ordering a 100-ton mill erected as soon as possible, together with a complete mining equipment. J. G. Sawyer is to be in charge of the work.

LOVELOCK, NEV.—Dec. 14

An Industrious Little Badger was unconsciously the cause, this week, of the discovery of a new antimony lead at Antelope Springs, about 25 mi. from here, which gives great promise. While digging his hole, the badger threw out small portions of float rich in antimony. J. H. Caustin noticed these specimens while prospecting. He made an investigation which resulted in the uncovering at the grass roots a lead that runs between 50 and 60% antimony. The vein is 5 ft. wide at the surface, and has been uncovered for a distance of 40 ft. Ten tons of this ore was removed in one day.

MORENCI, ARIZ.—Dec. 16

Strikers Held up and Searched two A. & N. M. trains few miles below Clifton last week. Contractors who had agreed to do Arizona Copper Co.'s assessment work were run out of town, although contractors offered wages that the strikers were asking for. If the union does not change its attitude about the assessment work the Detroit and Arizona companies will have 155 mining claims go by default.

LEAD, S. D.—Dec. 18

In the Black Hills, there has been comparatively little activity during the past year—except in tungsten, owing to the phenomenal rise in price of that metal. Several carloads have been shipped by Wasp No. 2 and one by Homestake, the latter being from the old Hidden Fortune ground. Selected high-grade ore as shipped is reported nearly 50% tungsten trioxide, but there is much of lower grade, and the Wasp is installing a concentrator to treat this. The ore is wolframite. No new deposits have been announced. The Wabel property near Hill City was sold during the year. Much prospecting has been done in a small way for other rare elements, but though molybdenum, vanadium, and uranium have all been found in the Hills, no occurrence of commercial importance is known. Changes at the Homestake consist in the remodeling of the B. & M. (or Old Abe) shaft, now equipped with a Nordberg hoist; an Edgemoor boiler plant supplies steam to this and a turbo-generator plant auxiliary to the Spearfish hydroelectric system, some current having hitherto been purchased. The Hanna pumping station has also been electrified. Metallurgical changes—in the direction of increasing the weight of stamps, using heavier heads, and casting mortars with open fronts and backs—have been made. Labor conditions are unchanged. The Homestake, following the practice of the past few years, has announced that a 7% addition to the year's wages will be paid to all employees on the December payroll. Trojan, Golden Reward, and Mogul continue running on the same scale as last year.

BIWABIK, MINN.—Dec. 18

Shortage of Labor being keenly felt in this district. At the Bangor and Mohawk mines difficulty was experienced in securing enough men for third shift. Several hundred more men could be given full winter's work here this season. In Virginia District the situation is not so acute. Virginia & Rainy Lake Lumber Co. has established 17 camps, employing upward of 3,000 men, at wage increase of 50% over last season. The various mining companies centering at Virginia will keep 2,000 men at work through the winter, while an equal number are employed at Chisholm. Outlook is that labor costs will keep pace with advanced ore prices for 1916. With the European sources of labor closed, if the prediction of a 55,000,000-ton production is to be realized, it seems that laborer will participate in war profits.

TORONTO—Dec. 18

The King Dodds Vein, the discovery of which occasioned the Kowkash gold rush, has pinched out a few feet below the surface, according to information received at the Ontario Bureau of Mines. The report of Percy E. Hopkins, who investigated the district some weeks since, is stated to be satisfactory especially as regards other veins found further west along the line of the National Transcontinental Railway, but is not being published—as it was considered that sufficient development had not been carried on to permit examination as a basis for determining the extent of the orebodies.

There Is Much Complaining among the mining men of Manitoba as to the operation of the provincial mining law which requires a mining company to be on a dividend-paying basis before stock can be offered to the public. It is asserted that this provision makes it very difficult to secure capital for legitimate development purposes, and that it has the effect of giving the control to American capitalists, who buy up claims at a low price and organize companies in the United States. Prof. Wallace, of Manitoba University, who has been delivering a series of lectures on the gold deposits of the province, has made the suggestion that sales of stock in non-dividend-paying companies should be permitted on the condition that the money so secured should be placed in the hands of trustees, who would see that it was properly expended for the development and equipment of the mines.

The Mining News

ARIZONA

Cochise County

DRAGOON TUNGSTEN (Dragoon) — Arizona's biggest tungsten producer. Shipping 6 tons concentrates daily to reduction works at Rochester, N. Y.

Mohave County

ORPHAN (Secret Pass)—O. T. James is milling about 1 ton every 8 hr. with 2-stamp mill and is saving $10 per hour.

LEVIATHAN COPPER (Cedar)—Has shaft down 200 ft. and has opened up large deposits of ore, carrying copper and molybdenum.

AMERICAN MOLYBDENUM (Cedar)—Company has built oil flotation and concentration plant of about 25 tons capacity for experimentation purposes. Ore assaying from 2% to 25% in molybdenum has been found in shaft on 12-ft. ledge.

UNION BASIN (Golconda)—Operating Golconda mine, 20 mi. north of Kingman, has declared $85,000 dividend, second of the same size since present owner, N. L. Amster, of Boston, acquired control, June 1, 1915. Company is building oil flotation plant and an electric power line from Kingman. The main shaft is now 900 ft. deep.

Pima County

CALERO (Twin Buttes)—Green, Adams and Page have bought this mine and have begun to ship 4½% copper ore.

CACILLO (Tucson)—This property, 40 mi. west of Tucson, is reported bonded for $150,000. Julian Johnson has developed mine, hauling ore to Tucson for shipment to El Paso smelter.

MARY JANE (Nogales)—A. D. McGhan is building wagon road to this property, 14 mi. north of Nogales. He intends to drive tunnel into hill, which has several veins of gold, silver and copper on surface.

NEW VENTURE PLACER (Amado Station)—Company is taking out about 100 cu.yd. per day, average $1.25 per yd. Recently installed Clark dry machines. Property is 60 mi. southwest of Tucson and 20 mi. west of Amado. L. C. Friend, manager. Estimated 4,200 acres of gravel, averaging $1 per cu.yd. Papago Indians and Mexicans have known and worked placers for many years.

Yavapai County

MORE LOCATION NOTICES were filed in first 11 months of this year in Yavapai county than in whole of 1914. Up to first of December 1115 notices had been filed as compared with 850 for year 1914. November was record-breaking month exceeding all records since the spring of 1907.

COPPER QUEEN GOLD (Mayer)—Is preparing to resume operations after several months' idleness.

BLACK CHIEF (Prescott)—Plans for refinancing completed; active operations will begin at once. New pumping plant to be installed.

CALIFORNIA

Amador County

KELLY (Jackson)—Tunnel being retimbered at portal and other repairs being made. Property situated about 3 mi. south of Jackson; formerly operated by Owen Kelly. After his death property purchased by Charles Vicini.

JOE DAVIS (Amador City)—William J. McGee, United States subtreasurer, has secured control of property known as North California and Joe Davis Mines. Former directors resigned and following have been elected: W. J. McGee, Ralph McGee, C. R. Downs, Charles Gillis, Emma Parrow. Assessment of 5c. per share levied. Office of company removed to Sutter Creek.

Calaveras County

PIONEER CHIEF (San Andreas)—Three new transformers installed. Development showing good results; day and night shifts being worked. Joseph E. King is superintendent.

CULLOCH (Angels Camp)—Property taken over by Thomas Lane. Was formerly producer; been idle number of years. The 200-ft. shaft will be deepened to 800 ft.

ROBBERS ROOST (Nimshew)—Pay gravel is being worked and company has done large amount of development including construction of reservoir and drain tunnel half-mile long.

Eldorado County

GEORGIA SLIDE (Georgetown)—Property being developed under bond taken by Eastern men, represented by Robert E. Cranston, of San Francisco. Teams and motor-trucks are hauling in supplies. Air compressor and other machinery will be installed.

Inyo County

POWELL'S CAMP west of Randsburg is showing a great deal of activity. Roschl, Lawrence, Watchman, Sanderson and Powell are extracting large amounts of low-grade tungsten ore.

CERRO GORDO (Keeler)—Contract made with Southern Sierras Power Co. for electric power for mine and camp purposes. Transmission by pole line from Keeler.

SKIDOO (Skidoo)—An oil-fired boiler has been installed for heating cyanide solution.

Nevada County

GOLDEN CENTER (Grass Valley)—New hoist put in operation Dec. 4. The 10-stamp mill will be doubled and cyanide plant installed.

UNION (North Bloomfield)—Tunnel will be driven 40 ft. further where it will intersect bottom of old incline shaft that was sunk to gravel channel.

Sierra County

OXFORD-GOLD BLUFF (Downieville)—Aërial tramway being installed to transport ore from Oxford ground to Gold Bluff mill. Both mines operated by Cliff Leasing Co., of Salt Lake City.

TWENTY-ONE (Alleghany)—Following judgment for $25,000 and costs by Federal Court at San Francisco, in favor of U. S. Senator William Flynn, of Pittsburgh, Penn., against officers and stockholders, on charge of selling him "salted" mine, comes information of strike of bonanza ore of same character as that produced by Tightner, Oriental and other famous mines on same serpentine belt. F. M. Phelps in charge of operations.

COLORADO

Summit County

TONOPAH PLACERS (Breckenridge) — Is operating three boats full time.

FRENCH GOLD DREDGING (Breckenridge) — Operating the Reiling boat is making average recovery of $1,300 per day. When digging along south bank many good sized nuggets are found, while few are found on north bank, indicating apparently the chief enrichment came originally from mountains to the south.

IDAHO

Shoshone County

STANLEY (Burke) — Shipped car of gold-antimony ore from near surface. Driving crosscut to gain depth.

NORTHERN LIGHT (Pine Creek via Kingston)—Main shaft will be sunk 200 ft. from 200 level. Lead, zinc and silver have been found in upper levels. B. G. Harmon is manager.

NEVADA-STEWART (Pine Creek via Kingston)—Will be equipped with compressor and drills. Crosscut will be driven to cut vein at depth of 400 ft.

BIG CREEK LEASE (Kellogg)—W. R. Hughes is driving crosscut from Big Creek vein to Polaris vein, which traverses Yankee Boy ground as parallel vein system.

WISCONSIN (Moon Gulch)—Mine has been unwatered to 90-ft. level and crosscut started to vein, supposed to be about 50 ft. from shaft. After driving on this level, will sink to 200.

HIGHLAND-SURPRISE (Kellogg)—Alterations and additions to mill have been completed with exception of flotation plant, which will be completed by first of year, when regular shipments of concentrates will begin. Ore is lead-zinc and mine has large reserve.

NATIONAL (Mullan)—After two weeks try out, National mill now in good working order; running on full time. Was first in district to introduce flotation. New 1,200 level in ore of better grade than levels above. Ore is copper and management is quoted as stating that an average of 1½% will pay, although higher average is expected.

POLARIS (Kellogg)—Polaris Development and Mining Co. organized this week, preparing to begin operations on Polaris taken under bond. Was developed many years ago by drift and shaft 160 ft. deep. Ore is gray copper running high in silver; extensive shipments were made in early days. Three-mile wagon road has been rebuilt, new building erected, and compressor, hoist and pump ordered. Colonel W. E. Mann is in charge.

PATUXENT (Wallace)—Important strike made at depth of 550 ft. Property on Nine Mile joins Rex on north, being explored by crosscut from Rex tunnel No. 2. Vein proved to 50 ft. wide. Along hanging wall there is 6 ft. of lead-zinc ore about equally divided and of good milling grade. Control of Patuxent owned by James F. Callahan, original owner of Callahan mine and largest individual stockholder in Consolidated Interstate-Callahan.

MICHIGAN

Iron

VOLUNTEER (Palmer)—One hundred and fifty men now employed. One hundred and sixty thousand tons of ore sold for 1916 delivery.

ODGERS (Crystal Falls)—Shaft work started two weeks ago. Quicksand encountered at 15 ft. passed through successfully. Ledge struck at 26 ft. Rock drills are now being used. Believed that mine will be in shape for hoisting next summer.

SPEIS (Iron River)—This is name of new Cleveland-Cliffs Iron Co. property. Twelve forties are under option. Two have been leased. Shaft work will start shortly. Sixteen buildings to be erected. Contract has been awarded. Drilling was done three years ago. Good body of ore developed; lies 51 ft. below sand and gravel. Spur line being surveyed.

CLEVELAND - CLIFFS (Ishpeming) — Stockholders at a special meeting just held, authorized an increase in the capital stock from $5,000,000 to $10,000,000 and authorized directors to make disposition of the new stock, which they will do some time this year. Company resumed dividend payments in October after discontinuance about a year, the resumption being on a 10% basis. Stockholders have been notified of plan to issue $3,500,000 of collateral trust 6% bonds to reduce floating indebtedness and provide for future requirements.

MINNESOTA

D. & I. R. RY. (Two Harbors)—An appropriation has been made for the construction of new car and paint shops, 275x310 and 50x184 respectively. The changes are necessitated because of anticipated heavy tonnage of ore next season.

Duluth

CUYUNA-SULTANA (Ironton)—Planned to start stripping operations and construction of concentrator immediately after Jan. 1.

MINNESOTA STEEL (Duluth)—Actual steelmaking has begun at plant; operation thus far being confined to billets. Rail mill is ready for operation but is not being used.

FERRO (Manganese)—A 75x40 boiler house under construction, with space for four boilers. Compressor plant will have capacity for 15 drills. Company reports having contracted for sale of entire 1916 output, planned to be 150,000 tons.

Mesabi Range

HULL-RUST (Hibbing)—This pit produced 2,294,405 tons during past season, being leading producer in Lake Superior district.

MONTANA

Fergus County

BARNES-KING DEVELOPMENT (Kendall) — Estimated returns from 4,206 tons of ore treated at North Moccasin mine during November show $8.51 per ton. At Piegan-Gloster property near Marysville, 2,670 tons of ore treated during November, yielded $4.98 per ton.

Silver Bow County

BUTTE DULUTH (Butte)—Negotiations for sale of property are still going on.

BUTTE-ZENITH CITY (Butte)—Will begin unwatering 670-ft. shaft, and as soon as unwatered it will be sunk to 1,000-ft. level.

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ESPERANZA (El Oro)—A. C. Savage has left El Paso with several carloads of cyaniding and other mining supplies for El Oro. Esperanza, which has been shut down for several months, is starting up.

The Market Report

Metal Markets

NEW YORK—Dec. 22

The outstanding feature of last week was the sharp advance in th eprice for copper. Lead and tin also advanced. Spelter too was stronger.

Copper, Tin, Lead and Zinc

Copper—About the beginning of our last week of record, domestic manufacturers, especially some who have ammunition contracts, began to exhibit signs of nervousness. The storm of Dec. 13-14 and the disorganization of telephone and telegraph communication throughout New England, and the consequent inability to keep in touch with the market, played a part in this. However, the basic factor was the manner in which numerous manufacturers let themselves go short of the market, having failed to contract for the metal that they needed for their own products already sold. These manufacturers required copper for early delivery and in the first quarter of 1916. When they attempted to cover their shorts they found that copper was not easy to get; they had to hunt for it. One of the largest producers was so well sold ahead that it had none to offer. Another one withdrew from the market pending the negotiation of a spectacular piece of business. With these conditions the price was driven up sharply on business that was in no way extraordinary. Having risen to the level of about 20c., r. t., the market opened at 19.95@20c. on Dec. 20 and closed on that day at 20¼c., r. t. On Dec. 21 the opening was at 20¼c., r. t., and the closing at 20½c., r. t. On Dec. 22 the market opened at 20½c., r. t., and before the end of the day sales were made at 20¾c., r. t., with leading producers then asking 21c., r. t. Sales in England were made at £97½@101½ during the week.

On Dec. 22 was announced the consummation of a spectacular transaction whereby the British government purchased 60,000 long tons of copper from two leading American producing interests for delivery during 1916. The price was in the neighborhood of 20c. This copper was taken for delivery month by month during 1916.

Copper Exports from the United States in the week ended Dec. 4 are reported by the Department of Commerce at 20,332,109 lb.; the larger items being 7,871,554 lb. to France; 6,098,675 lb. to Great Britain; 2,581,374 lb. to Russia and 1,725,041 lb. to Italy. Imports for the week were 104,951 lb. metal and 1,777,888 lb. in ore and matte; 1,882,839 lb. in all, chiefly from Chile and Canada.

Tin—On Dec. 16 the market rose sharply on news that the British government intended to curtail exports until such time as a safe working stock should be accumulated in Great Britain. When it was learned, however, that the idea of a safe stock was about 4,000 tons, about 75% of which was already on hand, the buyers here refused to become excited, and toward the end of the week the price declined a little.

Lead—Business in this metal was very active and about Dec. 20 independent producers began to be able to realize premiums over the price of the A. S. & R. Co. on good round lots. Inquiries became brisk with indications that further large business will be consummated. There was some gossip as to whether ammunition manufacturers might not be short of lead, as they were of copper. If that were the case, a sharp advance in price for lead might be looked for, the unsold stocks in the hands of producers being very small.

Spelter—This market was extraordinarily confused. Several producers reported an entire absence of demand and no business done. Others reported a considerable aggregate of transactions, representing a fair demand from galvanizers, and a larger demand from brass makers. The supply of metal available for prompt delivery is very small, although a moderate tonnage is to be had, of course at substantial premiums. In this position brokers and dealers are playing a considerable part, and producing much confusion. Sales of prompt spelter by producers were reported at 17@17¼c. The aggregate of these sales was, however, relatively insignificant. The bulk of the business done by producers last week was for first-quarter delivery, for which the average appeared to be about 15½c. in the early part of the week, and 15¾c. in the latter part. At the close first-quarter spelter was offered at 16c., while 15½c. was bid for it. On the other hand, smelters are free sellers of second-quarter spelter at 13@14c., without finding much interest in that delivery on the part of buyers. The situation may be summarized as follows: Prompt spelter is very scarce. Producers are pretty well sold for the first quarter of 1916, but still have liberal quantities to offer for that delivery, sales of which at present represent the bulk of the business. Most producers are eager sellers for the second quarter.

Arrivals at Baltimore for the week included 6,527 tons zinc concentrates from Port Pirie, Australia.

Zinc Sheets, base price remains at $22 per 100 lb. f.o.b. Peru, Ill., less 8% discount. Business has been steady, with good sales forward.

DAILY PRICES OF METALS IN NEW YORK

Dec.	Sterling Exchange	Silver, Cts. per Oz.	Copper	Tin	Lead		Zinc
			Electrolytic, Cts. per Lb.	Spot, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.	St. Louis, Cts. per Lb.
			19.45		5.30		14.50
16	4.7194	54⅛	@19.55	39	5.40	@5.32½	@16.50
			19.50			5.30	14.50
17	4.7188	54⅛	@19.75	40	5.40	@5.32½	@16.50
			19.70			5.30	14.50
18	4.7200	54¼	@19.80	40	5.40	@5.32½	@16.50
			19.70		5.40	5.30	15.00
20	4.7194	54⅜	@20.00	40	@5.45	@5.32½	@16.50
			20.00		5.40	5.30	15.00
21	4.7225	54⅜	@20.25	39½	@5.45	@5.32½	@16.50
			20.25		5.40	5.30	15.00
22	4.7275	54⅛	@20.50	39	@5.45	@5.32½	@16.50

The quotations herein are our appraisal of the average markets for copper, lead, spelter and tin based on wholesale contracts for the ordinary deliveries of the trade as made by producers and agencies; and represent, to the best of our judgment, the prevailing values of the metals, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.17c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The price quoted for copper on "regular terms" is the gross price including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.20c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Prime Western brands. Only the St. Louis price is herein quoted, St. Louis being the basing market. We quote the New York price at 17c. per 100 lb. above the St. Louis price.

Silver quotations are in cents per troy ounce of fine silver.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1c.

LONDON

Dec.	Silver	Copper				Tin		Lead		Zinc	
		Standard		Electrolytic							
		Spot	3 Mos.	£ per Ton	Cts. per Lb.	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts. per Lb.
16	25 11/16	79⅛	79¾	97½	20.55	165	165½	28¾	6.06	90	18.96
17	25 11/16	80⅜	81½	98	20.65	167½	168½	28¾	6.05	90	18.95
18	26	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	26 1/16	82⅞	83⅛	99½	21.07	168½	169	28⅞	6.08	90	18.96
21	26 1/16	84¼	84½	100½	21.18	167½	168½	29	6.11	90	18.97
22	25 11/16	82¾	82¾	100½	21.19	166	167	29	6.12	90	18.98

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for electrolytic, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21½c.

CLEVELAND - CLIFFS (Ishpeming) — Stockholders at a special meeting just held, authorized an increase in the capital stock from $5,000,000 to $10,000,000 and authorized directors to make disposition of the new stock, which they will do some time this year. Company resumed dividend payments in October after discontinuance about a year, the resumption being on a 10% basis. Stockholders have been notified of plan to issue $3,500,000 of collateral trust 6% bonds to reduce floating indebtedness and provide for future requirements.

MINNESOTA

D. & I. R. RY. (Two Harbors)—An appropriation has been made for the construction of new car and paint shops, 275x310 and 50x184 respectively. The changes are necessitated because of anticipated heavy tonnage of ore next season.

Duluth

CUYUNA-SULTANA (Ironton)—Planned to start stripping operations and construction of concentrator immediately after Jan. 1.

MINNESOTA STEEL (Duluth)—Actual steelmaking has begun at plant; operation thus far being confined to billets. Rail mill is ready for operation but is not being used.

FERRO (Manganese)—A 75x40 boiler house under construction, with space for four boilers. Compressor plant will have capacity for 15 drills. Company reports having contracted for sale of entire 1916 output, planned to be 150,000 tons.

Mesabi Range

HULL-RUST (Hibbing)—This pit produced 2,294,405 tons during past season, being leading producer in Lake Superior district.

MONTANA

Fergus County

BARNES-KING DEVELOPMENT (Kendall) — Estimated returns from 4,206 tons of ore treated at North Moccasin mine during November show $8.51 per ton. At Piegan-Gloster property near Marysville, 2,670 tons of ore treated during November, yielded $4.98 per ton.

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Tin—On Dec. 16 the market rose sharply on news that the British government intended to curtail exports until such time as a safe working stock should be accumulated in Great Britain. When it was learned, however, that the idea of a safe stock was about 4,000 tons, about 75% of which was already on hand, the buyers here refused to become excited, and toward the end of the week the price declined a little.

Lead—Business in this metal was very active and about Dec. 20 independent producers began to be able to realize premiums over the price of the A. S. & R. Co. on good round lots. Inquiries became brisk with indications that further large business will be consummated. There was some gossip as to whether ammunition manufacturers might not be short of lead, as they were of copper. If that were the case, a sharp advance in price for lead might be looked for, the unsold stocks in the hands of producers being very small.

Spelter—This market was extraordinarily confused. Several producers reported an entire absence of demand and no business done. Others reported a considerable aggregate of transactions, representing a fair demand from galvanizers, and a larger demand from brass makers. The supply of metal available for prompt delivery is very small, although a moderate tonnage is to be had, of course at substantial premiums. In this position brokers and dealers are playing a considerable part, and producing much confusion. Sales of prompt spelter by producers were reported at 17@17¼c. The aggregate of these sales was, however, relatively insignificant. The bulk of the business done by producers last week was for first-quarter delivery, for which the average appeared to be about 15½c. in the early part of the week, and 15¾c. in the latter part. At the close first-quarter spelter was offered at 16c., while 15½c. was bid for it. On the other hand, smelters are free sellers of second-quarter spelter at 13@14c., without finding much interest in that delivery on the part of buyers. The situation may be summarized as follows: Prompt spelter is very scarce. Producers are pretty well sold for the first quarter of 1916, but still have liberal quantities to offer for that delivery, sales of which at present represent the bulk of the business. Most producers are eager sellers for the second quarter.

Arrivals at Baltimore for the week included 6,527 tons zinc concentrates from Port Pirie, Australia.

Zinc Sheets, base price remains at $22 per 100 lb. f.o.b. Peru, Ill., less 8% discount. Business has been steady, with good sales forward.

DAILY PRICES OF METALS IN NEW YORK

Dec.	Sterling Exchange	Silver, Cts. per Oz.	Copper	Tin	Lead		Zinc
			Electrolytic, Cts. per Lb.	Spot, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.	St. Louis, Cts. per Lb.
16	4.7194	54⅛	19.45 @19.55	39	5.40	5.30 @5.32½	14.50 @16.50
17	4.7188	54⅛	19.50 @19.75	40	5.40	5.30 @5.32½	14.50 @16.50
18	4.7200	54⅛	19.70 @19.80	40	5.40	5.30 @5.32½	14.50 @16.50
20	4.7194	54⅜	19.70 @20.00	40	5.40 @5.45	5.30 @5.32½	15.00 @16.50
21	4.7225	54⅜	20.00 @20.25	39½	5.40 @5.45	5.30 @5.32½	15.00 @16.50
22	4.7275	54⅛	20.25 @20.50	39	5.40 @5.45	5.30 @5.32½	15.00 @16.50

The quotations herein are our appraisal of the average markets for copper, lead, spelter and tin based on wholesale contracts for the ordinary deliveries of the trade as made by producers and agencies; and represent, to the best of our judgment, the prevailing values of the metals, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.17c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The price quoted for copper on "regular terms" is the gross price including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.20c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Prime Western brands. Only the St. Louis price is herein quoted, St. Louis being the basing market. We quote the New York price at 17c. per 100 lb. above the St. Louis price.

Silver quotations are in cents per troy ounce of fine silver.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1c.

LONDON

Dec.	Silver	Copper				Tin		Lead		Zinc	
		Standard		Electrolytic							
		Spot	3 Mos.	£ per Ton	Cts. per Lb.	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts. per Lb.
16	25 11/16	79⅛	79⅜	97½	20.55	165	165½	28¼	6.06	90	18.96
17	25 11/16	80⅜	81¼	98	20.65	167½	168½	28¼	6.05	90	18.95
18	26	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	26 1/16	82⅛	83⅛	99½	21.07	168½	169	28⅞	6.08	90	18.96
21	26 1/16	84¼	84¼	100½	21.18	167½	168½	29	6.11	90	18.97
22	25 15/16	82⅛	82⅛	100⅛	21.19	166	167	29	6.12	90	18.98

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for electrolytic, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21⅜c.

Other Metals

NEW YORK—Dec. 22

Aluminum—The market is not so stiff, there being less pressure to buy, while supplies are a little better now, with a prospect of more to be had before long. Prices are a little easier, current quotations being 57@58c. for No. 1 ingots, New York.

Antimony—The market shows little change from last week, but is not specially active. Quotations are a shade easier. Chinese and other ordinary brands are held at 38@39½c. per lb., according to size of order. Cookson's is scarce and such as is available is held at 55c. per lb., New York.

In the "Journal" of Dec. 4 ordinary brands of antimony were quoted at 40c. per lb. for large lots, but it was mentioned that 42½c. had been named on some small business. Replying to an inquiry, we consider that the average price for antimony, ordinary brands, at that time was 40c., and so quote.

Quicksilver—The market is strong and active, sales being limited by supplies, which are still restricted. New York price is $130 per flask of 75 lb. for large orders, $135 per flask for smaller lots. San Francisco reports by telegraph an active market; sales earlier in the week at $115@120 per flask, with some dealers holding today at $130 per flask. London price is unchanged at £16 12s. 6d. per flask, with no discount from second hands.

Nickel—Business is good, with about the usual demand. Quotations for ordinary forms are 45@50c. per lb., according to size and terms of order. A premium of 5c. per lb. is charged for electrolytic nickel.

Gold, Silver and Platinum

NEW YORK—Dec. 23

Platinum—The market is excited and uncertain, supplies being still very limited and the future not all clear. It is difficult to fix prices, and dealers decline to make quotations except to regular customers. Sales are reported all the way from $90 up to $100 per oz. for refined platinum.

Our Russian correspondent writes that the market is very firm. A further increase of prices for the last fortnight is to be noted, partly owing to the rise in foreign exchange, partly in connection with the persistent demand both for internal markets and for abroad. Dealers abstain from sales, expecting yet higher prices. The quotations are: In Petrograd, 57,000@58,000 rubles per pood; at Ekaterinburg, 15 rubles per zolatnik, for crude metal, 83% platinum. These are equivalent to $56.40 and $56.35 per oz., respectively.

Silver has been fairly steady tne past week. The approach of the holidays has brought on dullness in the general trading. Continental coinage demand may revive at any moment, and then there should be some improvement in price.

Zinc and Lead Ore Markets

PLATTEVILLE, WIS.—Dec. 18

The best price paid this week for 60% zinc ore was $88@100 per ton. The base price paid for 80% lead ore was $70 per ton. Shipments were curtailed by shortage of electric-drive power, occasioned by improvements being made at the central power plant of the Interstate Light and Power Co.

SHIPMENTS WEEK ENDED DEC. 18

	Zinc Ore, Lb.	Lead Ore, Lb.	Sulphur Ore, Lb.
Week	3,999,000	566,400	463,300
Year	203,210,750	7,195,540	29,088,510

Shipped during week to separating plants, 3,604,000 lb. zinc ore.

JOPLIN, MO.—Dec. 18

Blende, high price, $106.60; base per ton, 60% zinc, premium ore, $105; medium, $104@95; lower grades down to $85; calamine, base 40% zinc, $70@65; average selling price, all grades of zinc, $90.30 per ton. Lead ore, high price, $74.40; base per ton 80% metal content, $70@73; average selling price, all grades of lead, $71.66 per ton.

SHIPMENTS WEEK ENDED DEC. 18

	Blende	Calamine	Lead	Values
Totals this week...	9,819,400	919,220	2,162,970	$562,300
Totals this year...	567,310,780	44,629,950	89,263,810	$26,320,850

Blende value, the week, $455,420; 51 weeks, $22,737,530.

Calamine value, the week, $29,370; 51 weeks, $1,156,290.

Lead value, the week, $77,510; 51 weeks, $2,427,030.

Last week's week-end buying, with some early buying this week, on a little higher price level than the general price of last week, was sufficient to create an excitement that advanced premium ores this week $15 per ton. The purchasers of premium ore are looking ahead a little, too, as a vacation of two weeks during the holidays will be observed by producers of high-grade ores more certainly than by producers of medium- or lower-grade ores. A light tonnage is reported, mainly because general buying was so late.

Iron Trade Review

NEW YORK—Dec. 22

The iron and steel markets continue to show unprecedented activity for this season of the year. The mills are being pressed with orders which they will have much difficulty in filling in anything like the time wanted. Domestic business is increasing, while export orders, after hesitating for a time, are coming in again rapidly.

The pressure for materials for car building, ship building and structural work is becoming strong. Structural business, which was rather slow for a time, is increasing rapidly. Fabricators in the East have taken large contracts and are urging deliveries of steel to prevent delays.

The pig-iron market is strong and active. Foundries, which have not contracted far ahead are finding difficulty in getting iron except at an advanced price.

Freight congestion has been increased by bad weather and is presenting serious difficulties. Some furnaces have been hampered by trouble in getting coke as they need it.

Some progress has apparently been made with the organization of the new combination which is to include the Cambria Steel, the Lackawanna Steel and the Youngstown Sheet and Tube companies. Options have been taken on the stock, but no definite details has been given out. The Republic Iron and Steel Co. is not concerned in the merger.

Pig-iron production in Alabama in November is reported at 212,000 tons.

Iron and steel exports for which quantities are reported are given by the Bureau of Commerce in October at 351,251 long tons, against 147,293 tons in October, 1914. For the 10 months ended Oct. 31 the total so reported was 1,291,018 tons in 1914, and 2,818,679 tons in 1915; an increase of 1,527,661 tons.

PITTSBURGH—Dec. 21

In point of new buying finished steel products are much less active this week. While with such a rush to buy in the past few weeks, and mills now so thoroughly sold up, a decrease in activity was unavoidable, the sharpness of the decrease is attributed to the arrival of the holiday season. There is as great a disposition as ever to specify on current contracts, but the volume of this business is somewhat reduced, as many buyers had already specified their full quotas to Dec. 31.

Steel prices show as sharp an advancing tendency as ever. Wire products are up today $2 a ton, making nails $2.10. Bars, plates and shapes advanced last week from 1.70c., a price quoted by a few sellers on certain business, to a general minimum of 1.80c., and a further advance is predicted for early next month. Hoops are up $2 a ton to 2c., and black sheeets a like amount, to 2.60c. for 28 gage.

The Pennsylvania R.R. has placed an embargo on all iron and steel destined east for lighterage at Jersey City or Waverly, while the movement to line consumers is greatly congested. The coal and coke movement east is largely embargoed. The Baltimore & Ohio restrictions are almost equally severe. Railroad officials who a few weeks ago expressed confidence that the situation would soon improve now admit that it is not only worse, but may grow still worse in the next two or three weeks, particularly if bad weather intervenes.

In the circumstances iron and steel shipments for export are practically cut off. The mills are shipping correspondingly more material to the domestic trade, which is very glad to have the additional material. Total shipments of steel for export, direct and indirect, probably represent no more than about 20% of the total shipments at the present time.

Pig Iron—Inquiry for pig iron is by no means heavy, but small buying sends prices upward. There have been small sales of bessemer at $19.50, with no $19 iron in sight, and most sellers holding for $20. In foundry iron $18 is no longer heard, and $18.50, which was done a fortnight ago in the case of some deliveries, is now the minimum. Several small sales of basic iron are reported at $18, the quotation named in last week's report. Producers evidently expect a shortage of pig iron, and are predicting much higher prices. Consumers have all covered to an extent, but some are expected to require additional tonnages through their consumptive requirements having increased. There is some inquiry for foundry iron for third quarter, for which delivery furnaces quote 50c. higher than for early delivery. We quote: Bessemer, $19.50@20; foundry, $18.50@19; gray forge, $18@18.50; malleable, $18

@18.50; basic, $18, f.o.b. Valley furnaces, 95c. higher delivered Pittsburgh.

Ferromanganese—The market is much stronger. At least one English producer is quoting $110 on contract, Baltimore, instead of $100, while some domestic producers quote as high as $125 on contract. Prompt lots generally bring $100@105. Consumers have been buying steadily in the past few weeks and are probably fairly well covered for the next six to nine months.

Steel—After several weeks of a practically nominal market in billets there have been open-market sales of ordinary soft openhearth billets to the extent of several thousand tons at $35, maker's mill, Pittsburgh district, $4 a ton above the nominal quotation which some mills have lately mentioned as probably representing the market. It would appear that more openhearth steel could be sold at $35. Bessemer billets are quotable at about $32. Sheet bars would not be offered at lower prices than billets, but sheet mills could not afford to pay such prices, and must be content with their contract tonnages, which cover them fairly well. Forging billets are $52@55 and rods nominally $40 at mill.

FERROALLOYS

Ferrosilicon is in demand and firm. For high-grade, 50% up, the quotation is $83@85 per ton at furnace in the Pittsburgh District. Bessemer ferrosilicon is also firm, prices varying from $28 at furnace for 10% up to $38 for 16% alloy.—**Ferrotungsten** remains high with some variations in price.—**Tungsten** metal is a little easier; a sale is reputed this week at $6.50 per lb. for a lot of 1,000 lb., 98% pure.—**Molybdenum** metal is reported sold at $1.50 per lb. Most of the metal now offered is high in sulphur, and good metal is scarce.

FOREIGN IRON TRADE

British Foreign Trade in Iron and Steel and in manufactures thereof 10 months ended Oct. 31, as valued by the Board of Trade returns:

	Exports	Imports	Excess
Iron and steel	£32,736,119	£8,853,825	Exp. £23,882,294
Hardware, etc.	24,254,232	12,350,392	Exp. 11,903,840
Totals	£56,990,351	£21,204,217	Exp. £35,786,134
Totals, 1914	79,449,681	21,524,575	Exp. 57,925,106

The total tonnage of iron and steel exported, 3,441,157 tons in 1914, and 2,640,569 tons in 1915; imported, 1,502,648 tons in 1914, and 995,297 tons this year.

Pig-Iron Production in Germany in October is reported by the German Iron and Steel Union at 1,076,343 metric tons; which is 40,265 tons more than in September and about two-thirds of the normal output. For the 10 months ended Oct. 30 the total make was 12,746,729 tons in 1914, and 9,741,871 tons in 1915; a decrease of 3,004,858 tons this year.

Steel Production of Germany nine months ended Sept. 30, as reported by the German Iron and Steel Union, in metric tons:

	Basic	Acid	Total
Converter	4,829,819	118,003	4,947,822
Open hearth	3,883,319	177,922	4,061,241
Direct castings	321,553	124,931	446,484
Crucible	.....	75,441	75,441
Electric	.....	87,262	87,262
Total	9,034,691	583,559	9,618,250
Total, 1914	11,716,855	508,022	12,224,877

The total number of works in operation on Sept. 30, or at any time during the nine months, was 231, against 242 last year.

Swedish Iron Production for the seven months ended July 31 is reported as follows:

	1914	1915	Changes
Pig iron	432,000	426,500	D. 5,500
Wrought iron blooms	78,300	65,200	D. 13,100
Converter steel	63,000	52,200	D. 10,800
Openhearth steel	254,800	282,400	I. 27,600

The production of finished iron and steel in all forms for the first half of 1915 was 218,300 tons.

IRON ORE

Some large sales of Eastern iron ore have been made, doubtless stimulated by the Lake activity. Among these are heavy sales of Port Henry ore at 8¼@9c. per unit, delivered, which is about 75c. per ton over last year. Some lump ore is reported sold at $4 per ton at mine. A good tonnage of other New York and New Jersey ores has been sold at 8¼@8¾c. per unit, delivered.

Of the total shipments of Lake iron ore in November, 4,308,295 tons, or 97%, went to Lake Erie ports.

Imports at Baltimore for the week were 8,650 tons manganese ore from India and 5,600 tons from Brazil.

Imports of manganese ore in the United States in September were 29,959 tons. For the nine months ended Sept. 30, the imports were 215,274 tons in 1914 and 173,992 tons in 1915; a decrease of 41,282 tons, or 19.2%, this year.

An interesting table, published by the "Iron Trade Review," gives the season prices of Lake Superior iron ore for 27 years. The highest quotations were in 1890, when Old Range ore brought $5.50 for bessemer and $5.25 for non-bessemer; no Mesabi ore was then being shipped. Since that year the highest prices were in 1899, when $5.50 was paid for Old Range and $4.50 for Mesabi bessemer: $4.20 for Old Range and $4 for Mesabi nonbessemers. Other high years were 1906 and 1909, when the rates were $5 for Old Range and $4.75 for Mesabi bessemers; $4.20 and $4 for nonbessemers. The rates for 1916 are higher than in 16 out of 27 years.
to foreigners as well as to Spanish subjects.

OTHER ORES

Some trial shipments of antimony ore have been made from Honduras to New York. The mine has been known for some time, but has been little worked on account of transportation difficulties. The ore shipped is mined in the vicinity of the interior village of Voro and has to be transported six days by pack mule to the Sulaco River, thence two days by canoe down the river to Pimienta, where rail connection is made for Puerto Cortes.

Señor D. Domingo Orueta, who recently discovered in Spain deposits of platinum, chromium and nickel, has relinquished his claims to the Spanish Government. By royal decree, published Nov. 17 in the "Gaceta de Madrid," official organ of the Spanish Government, the territorial limits of the mines are defined. Concessions to exploit the mines are obtainable from the Spanish Government by foreigners as well as natives.

COKE

Coke production for the week in the Connellsville region is reported by the "Courier at 451,896 short tons; shipments, 451,175 tons. Shipments of Greensburg and Upper Connellsville districts, 40,967 tons. No material increase is probable until labor conditions improve.

Coal Production of Austria nine months ended Sept. 30, in metric tons:

	1914	1915	Changes
Coal mined	11,700,541	12,088,961	I. 388,420
Brown coal	18,337,727	16,367,481	D. 970,246
Coke made	1,771,938	1,374,770	D. 397,168
Briquettes made	304,763	345,797	I. 41,034

Of the briquettes reported this year 190,047 tons were made from brown coal, or lignite.

Chemicals

NEW YORK—Dec. 29

The general market is fairly active with rather a strong tone. Business is for the most part good for this season of the year.

Arsenic—Business is quiet, but very steady and there is no change. Prices are $3.75@4 per 100 lb. for both spot and futures.

Copper Sulphate—Stocks are low and some large producers are out of the market for the time being. The quotations are unchanged at $10 per 100 lb. for carload lots and $10.25 per 100 lb. for smaller parcels.

Nitrate of Soda—Imports have been smaller recently and stocks not at all excessive. Prices continue firm at $3.20 per 100 lb. for spot and January; $3.15@$3.20 for futures.

Sulphuric Acid—The spot market is nominal with dealers' stocks very small. Large makers are in a position to name shipment figures and business is being booked for 1916, according to the "Oil, Paint and Drug Reporter." Contract shipments are quoted at $27@35 per ton in tanks for 60 deg., according to quantity and time of delivery. Contracts for 66 deg. $45@50 per ton for prompt, $37 per ton for first half of next year and $40 per ton over the year in tank cars. Smaller quantities in carboys command premiums according to size.

Imports and Exports of Fertilizing Chemicals in the United States nine months ended Sept. 30, in long tons:

	Imports		Exports	
	1914	1915	1914	1915
Kainit	229,041	6,646	.....	.....
Manure salts	157,710	13,647	.....	.....
Other potash salts	154,258	56,881	2,746	900
Nitrate of soda	430,136	669,383	7,384	16,846
Sulphate of ammonia	59,054	27,193	150	1,204
Phosphates	.....	.....	915,360	271,584

Exports include reëxports of foreign material. Some phosphates are imported, but are not given separately in the returns.

Assessments

Company	Delinqe	Sale	Amt.
Alpha, Nev.	Jan. 5	Jan. 26	$0.03
Argenta, Ida.	Dec. 20	Jan. 22	0.001
Basalt, Nev.,	Nov. 29	Dec. 30	0.0025
Beaver Butte, Utah	Dec. 11	Jan. 3	0.0025
Buffalo, Con., Utah	Dec. 18	Jan. 8	0.002
Cedar Creek, Ida.	Dec. 30	Jan. 29	0.01
Clear Grit, Ida.	Dec. 14	Jan. 5	0.0015
Columbus Ext., Utah	Dec. 11	Jan. 3	0.02
Confidence, Nev.	Dec. 24	Jan. 14	0.10
Demijohn Cons., Nev.	Jan. 7	Jan. 27	0.005
Dry Canon Cons., Utah	Dec. 18	Jan. 17	0.001
E. Hercules Ext., Ida. (post.)	.....	Jan. 11	0.0015
Eureka M & M., Ida.	Nov. 26	Dec. 27	0.001
Federal Ely, Nev.,	Dec. 16	Jan. 17	0.005
Four Timbers, Wash.	Dec. 24	Jan. 20	0.001
Golden State M & M., Calif.	Dec. 6	Dec. 28	0.005
Hancock Cons., Mich.	Jan. 3	.....	1.00
Hypotheek, Ida.	Dec. 20	Jan. 20	0.005
Ida. & L. Angeles, Ida., (post.)	.....	Jan. 27	0.005
Laclede, Ida.	Dec. 6	Dec. 27	0.003
Lucky Calumet Cop., Ida.	Dec. 27	Jan 28	0.005
Lynn Big Six, Nev.,	Nov. 30	Jan. 3	0.005
M & P Gold, Utah	Dec. 13	Jan. 3	0.0025
Murray Copper, Utah	Dec. 18	Jan. 10	0.001
Nevada-Anaconda, Utah	Dec. 29	Jan. 29	0.002
Nevada-Douglas, Nev.	Nov. 30	Dec. 31	0.10
New Baltic, Mich.	Jan. 15	.....	0.50
Nyala Metals, Nev.	Dec. 17	Jan. 8	0.01
Old Veteran, Ida.	Jan. 6	Jan. 29	0.002
Oreano, Ida.	Dec. 18	Jan. 18	0.001
Phoenix, Mich.	Jan. 1	.....	1.00
Rescue Eula, Nev.	Dec. 6	Jan. 10	0.01
Rio Grande Grub Stake, Utah	Dec. 25	Jan. 15	0.006
Seg. Belcher & Midas, Nev.	Dec. 12	Jan. 6	0.02
Selma, Utah	Dec. 15	Jan. 2	0.008
Sheba Gold, Utah	Dec. 6	Jan. 8	0.05
Sunset Dev., Ida.	Dec. 8	Jan. 3	0.002
Tar Baby, Utah	.....	.....	0.005
Tarbox, Ida.	Dec. 24	Jan. 15	0.003
Tintic Standard, Utah	Nov. 29	Dec. 27	0.005
Tonopah Midway, Nev.	Dec. 11	Jan. 11	0.01
Uvada, Utah	Nov. 22	Dec. 27	0 02
Utah-Arizona, Ariz.	Dec. 14	Jan. 6	0 004
Victoria, Utah	Dec. 28	Jan. 29	0.01
Western Star, Ida.	Jan. 10	Jan. 31	0.001
West Toledo, Utah	Dec. 16	Jan. 3	0.01

Stock Quotations

COLO. SPRINGS	Dec. 20	SALT LAKE	Dec. 20
Name of Comp.	Bid.	Name of Comp	Bid.
Acacia	.02	Beck Tunnel	.07½
Cripple Cr'k Con.	.009	Black Jack	.08½
C. K. & N.	‡.02	Colorado Mining	.08
Doctor Jack Pot.	.09½	Crown Point	.01
Elkton Con.	.30½	Daly-Judge	7.50
El Paso	.76	Emma Cop	.17
Findlay	.03½	Gold Chain	.50
Gold Dollar	‡.02	Grand Central	.53
Gold Sovereign	.06	Iron Blossom	.98
Golden Cycle	1.96½	Lower Mammoth	.05
Isabella	.19	May Day	.18½
Jack Pot	.06½	Opohongo	.00½
Jerry Johnson	.04½	Prince Con.	.79
Lexington	.005	Seven Troughs	.01½
Mary McKinney	.44½	Silver King Coal'n.	3.35
Pharmacist	.005	Silver King Con.	2.10
Portland	1.78½	Sioux Con.	.02½
Raven B. H.	.03	Uncle Sam	.07½
Vindicator	1.96	Yankee	.32½

SAN FRANCISCO	Dec. 20		
Alta	.10	Belmont	4.40
Andes	.06	Jim Butler	1.00
Best & Belcher	.04	Lone Star	.03
Caledonia	.40	MacNamara	.03
Challenge Con.	‡.04	Midway	.15
Chollar	‡.04	Mont.-Tonopah	.30
Confidence	.12	North Star	.14
Con. Virginia	.17	Rescue Eula	.07
Gould & Curry	.02	West End Con.	.75
Hale & Norcross	.03	Atlanta	.21
Jacket-Cr. Pt.	.15	Blue Bell	.02
Julia	.01	Booth	.39
Mexican	.26	C.O.D. Con.	.03
Occidental	.75	Comb. Frac.	.06
Ophir	.17	D'field Daisy	.03
Overman	.06	Jumbo Extension	1.17½
Potosi	‡.02	Pitts.-Silver Peak	.06
Savage	.05	Round Mountain	.40
Sierra Nevada	.31	Sandstorm Kendall	.07½
Union Con.	.62	Silver Pick	.05
Utah Con.	‡.01	Central Eureka	.05

TORONTO	Dec. 20		
Bailey	.05	Dome Exten.	.39½
Chambers Ferland	.30½	Dome Lake	.26
Conlagas	4.75	Foley O'Brien	‡.50
La Rose	.65	Hollinger	28.75
Peterson Lake	.36½	Imperial	.04½
Right of Way	.05	Jupiter	.18½
Seneca Superior	.60	McIntyre	1.06
T. & Hudson Bay	23.00	Porcu. Crown	.89
Temiskaming	.60	Preston E. D.	.06½
Trethewey	.16	Vipond	.64
Wettlaufer-Lor.	.08	West Dome	.15½

LONDON	Dec. 5		
Alaska Tre'dwell	£6 12s 6d	Mexico Mines	£4 3s 9d
Burma Corp.	1 13 9	Nechi, pfd.	0 12 6
Cam & Motor	0 15 0	Oroville	0 14 3
Camp Bird	0 8 6	Santa Gert'dis.	0 10 6
El Oro	0 10 3	Tomboy	1 4 0
Esperanza	0 10 9	Tough Oakes	0 12 6

N. Y. EXCH.	Dec. 20	BOSTON EXCH	Dec. 20
Name of Comp.	Clg.	Name of Comp.	Clg.
Alaska Gold M.	26½	Adventure	1½
Alaska Juneau	10½	Ahmeek	392½
Am.Sm.&Ref.,com	102	Algomah	1½
Am. Sm. & Ref., pf.	111½	Allouez	57½
Am. Sm. Sec., pf. A	88½	Ariz. Com., ctfs.	7½
Am. Sm. Sec., pf. B.	84½	Bonanza	.35
Anaconda	86½	Butte Alex. Scott	9½
Batopilas Min.	3½	Butte-Ballaklava	2½
Bethlehem Steel	474	Calumet & Ariz.	67½
Bethlehem Steel, pf	145	Calumet & Hecla	540
Butte & Superior	65½	Centennial	16½
Chile Cop.	24	Copper Range	57
Chino	53½	Daly West	3½
Colo. Fuel & Iron	51	East Butte	15½
Crucible Steel	73½	Franklin	9½
Dome Mines	28½	Granby	79½
Federal M. & S.	28	Hancock	15½
Federal M. & S., pf.	52½	Hedley	29
Great Nor., ore, ctf.	48½	Helvetia	.40
Greene Cananea	47½	Indiana	5½
Guggen. Exp.	77½	Island Cr'k, com.	48½
Homestake	121½	Island Cr'k, pfd.	90
Inspiration Con.	44½	Isle Royale	27½
International Nickel	197	Keweenaw	2½
Lackawanna Steel	81	Lake	18½
Miami Copper	33½	La Salle	5
Nat'l Lead, com.	63½	Mason Valley	2½
National Lead, pf.	109½	Mass	11½
Nev. Consol.	15½	Mayflower	3½
Ontario Min.	10½	Michigan	1½
Quicksilver	4½	Mohawk	89
Quicksilver, pf.	4½	New Arcadian	9½
Ray Con.	24½	New Idria	10½
Republic I&S, com.	54½	North Butte	31½
Republic I&S, pf.	110½	North Lake	2½
Sloss-Sheffield	63	Ojibway	1½
Sloss-Sheffield, pf.	96½	Old Colony	3
Tennessee Copper	57½	Old Dominion	57
Utah Copper	78½	Osceola	85
U. S. Steel, com.	85½	Quincy	85½
U. S. Steel, pf.	116½	St. Mary's M. L.	58
Va. Iron C. & C.	65	Santa Fe	3½
		Shannon	7½

N. Y. CURB	Dec. 20		
Alta Con.	.15	Shattuck-Ariz.	33½
Am. Zinc	66½	So. Lake	5½
Beaver Con.	.41	Superior	25
Big Four	.05	Superior & Bost.	2½
Braden Copper	16	Tamarack	48½
Buffalo Mines	1.10	Trinity	9½
Butte & N. Y.	3	Tuolumne	.33
Butte C. & Z.	6½	U. S. Smelting	47½
Can. Cop. Corpn.	2 1/16	U. S. Smelt'g, pf.	48½
Cashboy	.07	Utah Apex	2½
Cerro de Pasco	37	Utah Con.	11½
Con. Ariz. Sm.	1½	Victoria	2½
Con. Coppermines	1½	Winona	3½
Con. Nev.-Utah	1/16	Wolverine	58
Dia. Black B.	.03	Wyandot	1½
Florence	.38		
Goldfield Con.	1 1/32	BOSTON CURB	Dec. 20
Goldfield Merger	.15	Bingham Mines	8
Hecla Min.	3½	Boston Ely	.28
Howe Sound	4½	Butte & Lon'n Dev.	.33
Kennecott Cop.	52½	Calaveras	2½
Kerr Lake	4½	Calumet-Corbin	.07
Magma	15	Chief Con.	1 1/16
Majestic	1 7/16	Cortez	.45
McKinley-Dar-Sa.	.55	Crown Reserve	.65
Mines of Am.	3½	Davis-Daly	1½
Mother Lode	.28	Eagle & Blue Bell	1½
Nevada Hills	.19	First Nat. Cop.	6
New Utah Bingham	5	Houghton Copper	2
Nipissing Mines	7½	Iron Cap Cop., pf.	6½
Oro	.05	Mexican Metals	.36
Ray Hercules	3½	Nat. Zinc & Lead	3½
St. Joseph Lead	13½	Nevada-Douglas	.75
South Utah	.37	New Baltic	2½
Stand'd Oil of N.J.	554	New Cornelia	‡9½
Standard S. L.	1½	Ohio Copper	.20
Stewart	½	Oneco	1
Success	.63	Raven Copper	.10
Tonopah	6 1/16	Rex Cons.	.35
Tonopah Ex.	3½	Smokey Dev.	.30
Tonopah Merger	.55	Tonopah Victor	‡.35
Tribullion	.75	United Verde Ext.	5½
White Knob, pf.	2	Utah Metal	10½
Yukon Gold	2½		

‡Last Quotations.

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1913	1914	1915	1913	1914	1915
January	62.938	57.572	48.855	28.983	26.553	22.731
February	61.642	57.506	48.477	28.357	26.573	22.753
March	57.870	58.067	50.241	26.669	26.788	23.708
April	59.490	58.519	50.250	27.416	26.958	23.709
May	60.361	58.175	49.915	27.825	26.704	23.570
June	58.990	56.471	49.034	27.199	25.948	23.267
July	58.721	54.678	47.519	27.074	25.219	22.597
August	59.293	54.344	47.163	27.335	25.979	22.780
September	60.640	53.290	48.680	27.986	24.260	23.591
October	60.793	50.654	49.385	28.083	23.199	23.925
November	58.995	49.082	51.714	27.263	22.703	25.094
December	57.760	49.375	.....	26.720	22.900	.....
Year	59.791	54.811	.....	27.576	25.314	.....

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York		London			
	Electrolytic		Standard		Electrolytic	
	1914	1915	1914	1915	1914	1915
January	14.223	13.641	64.304	60.756	69.488	65.719
February	14.491	14.394	65.259	63.494	70.188	*
March	14.131	14.787	64.276	66.152	69.170	*
April	14.211	16.811	64.747	75.096	69.313	*
May	13.996	18.506	63.182	77.600	67.786	*
June	13.603	19.477	61.336	82.574	66.274	95.333
July	13.223	18.796	60.540	76.011	64.955	91.409
August	*	16.941	‡	68.673	‡	82.333
September	*	17.502	‡	68.915	‡	85.250
October	*	17.686	‡	72.601	‡	88.000
November	11.739	18.627	53.227	77.744	‡	93.273
December	12.801	.....	56.841	.....	*	.....
Year	.....	.....	.....	.....	.....	.....

TIN

Month	New York		London	
	1914	1915	1914	1915
January	37.779	34.260	171.905	156.550
February	39.830	37.415	181.556	176.925
March	38.038	48.426	173.619	180.141
April	36.154	47.884	163.963	166.225
May	33.360	38.790	150.702	162.675
June	30.577	40.288	138.321	167.636
July	31.707	37.423	142.517	167.080
August	*	34.389	‡	151.440
September	32.675	33.125	‡	152.625
October	30.284	33.080	‡	151.554
November	33.304	39.224	139.391	167.670
December	33.601	.....	147.102	.....
Av. year	34.301	.....	.....	.....

LEAD

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	4.111	3.729	4.011	3.548	19.665	18.606
February	4.048	3.827	3 937	3.718	19.606	19.122
March	3.970	4.053	3.850	3.997	19.651	21.883
April	3.810	4.221	3.688	4.142	18.225	21.094
May	3.900	4.274	3.808	4.182	18.503	20.347
June	3.900	5.932	3.810	5.836	19.411	25.170
July	3.891	5.659	3.738	5.531	19.051	24.611
August	3.875	4.656	3.715	4.520	‡	21.946
September	3.828	4.610	3.658	4.490	‡	23.151
October	3.528	4.600	3.384	4.499	‡	23.994
November	3.683	5.155	3.585	5.078	18.500	26.278
December	3.800	.....	3.662	.....	19.097	.....
Year	3.862	.....	3.737	.....	.....	.....

SPELTER

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	5.262	6.386	5.112	6.211	21.533	30.844
February	5.377	8.436	5.228	8.255	21.413	39.819
March	5.250	8.541	5.100	8.366	21.460	44.141
April	5.113	10.012	4.963	9.837	21.569	49.888
May	5.074	14.781	4.924	14.610	21.393	68.100
June	5.000	21.208	4.850	21.038	21.345	100.614
July	4.920	19.026	4.770	18.856	21.568	97.250
August	5.568	12.781	5.418	12.611	‡	67.786
September	5.380	13.440	5.230	13.270	‡	67.841
October	4.909	12.800	4.750	12.596	‡	66.536
November	5.112	15.962	4.962	15.792	25.016	88.409
December	5.592	.....	5.430	.....	27.369	.....
Year	5.213	.....	5.061	.....	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton. * Not reported, ‡ London Exchange closed.

PIG IRON IN PITTSBURGH

Month	Bessemer		Basic		No. 2 Foundry	
	1914	1915	1914	1915	1914	1915
January	$14.94	$14.59	$13.23	$13.45	$13.99	$13.90
February	15.06	14.55	14.12	13.45	14.08	13.90
March	15.07	14.55	13.94	13.45	14.10	13.95
April	14.90	14.55	13.90	13.45	14.13	13.95
May	14.90	14.61	13.90	13.60	14.27	13.83
June	14.90	14.70	13.90	13.67	13.96	13.77
July	14.90	14.94	13.90	13.91	13.90	13.68
August	14.90	16.01	13.90	15.31	14.08	14.75
September	14.90	16.86	13.90	15.95	14.03	15.70
October	14.84	16.95	13.75	15.96	13.97	15.80
November	14.59	18.26	13.43	17.30	13.83	17.20
December	14.70	.....	13.45	.....	13.83	.....
Year	$14.88	.....	$13.78	.....	$14.01	.....

The Engineering and Mining Journal

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Advertising Index, Last Page

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The S-A Page

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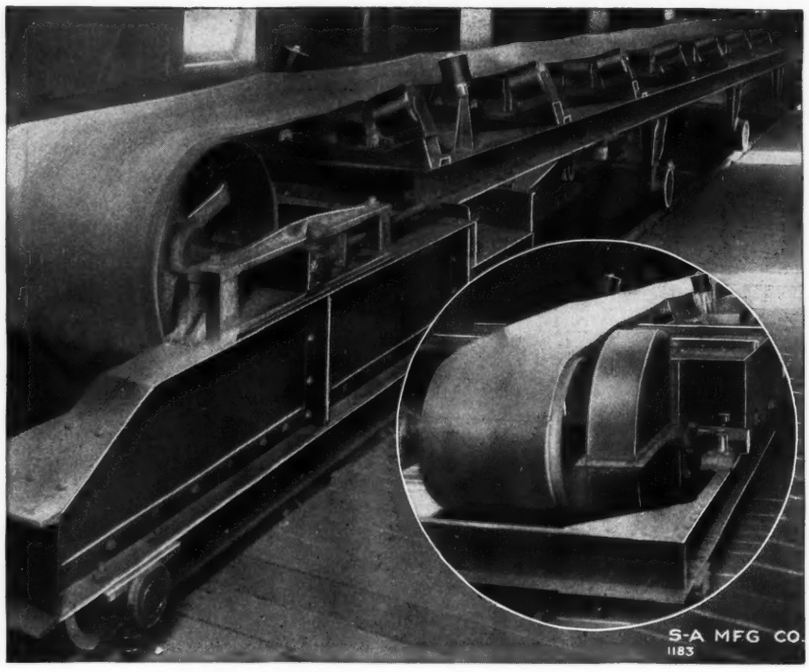

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The Engineering and Mining Journal

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VOLUME 100 DECEMBER 25, 1915 NUMBER 26

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WITH PRINCIPAL ARTICLES SUMMARIZED

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By C. Offerhaus

An interesting account of the Sulitjelma practice in smelting Elmore concentrates. After roasting in a Wedge mechanical furnace, the calcines are smelted in a gas-fired regenerative reverberatory furnace. A basic slag is made and the back part of the furnace is protected by magnesite brick and water cooling.
ENG. AND MIN. JOURN., Dec. 25, 1915

MEXICAN MINING TAX 1037

A petition transmitted to General Carranza by some of the large mining operators in Mexico in regard to the excessive taxation which is imposed upon the Mexican mining industry. This petition is given in full.
ENG. AND MIN. JOURN., Dec. 25, 1915

*DEVELOPMENT OF DREDGING IN YUKON TERRITORY 1039

A review of dredging developments in the North by the manager of the Yukon Gold Co. O. B. Perry tells Canadian Mining Institute members of the problems encountered in operating where climatic conditions and the situation of the deposits require preparation for what may be termed "intensive dredging" during the open season. Thawing frozen ground has greatly extended the dredgeable area. Costs of thawing and dredging for the last six years are presented.
ENG. AND MIN. JOURN., Dec. 25, 1915

*FLOTATION AT GOLD HUNTER MILL 1044

A description of metallurgical practice at a Cœur d'Alene mill in which flotation has been an important aid to commercial success. Careful step-concentration and flotation of slimes is the system used.
ENG. AND MIN. JOURN., Dec. 25, 1915

BUYS ORE LANDS IN CUBA 1046

The Midvale Steel and Ordnance Co. announced Dec. 8 that it had obtained 300,000,000 tons of iron ore in Cuba through the purchase of all the stock of the Buena Vista Iron Co. ENG. AND MIN. JOURN., Dec. 25, 1915

BROAD PASS REGION OF ALASKA 1046

Broad Pass is the western part of a wide glacial valley which is bordered by steep, straight mountain walls lying parallel with a great east-west range on the north and connecting the upper valleys of Chulitna and Susitna Rivers. ENG. AND MIN. JOURN., Dec. 25, 1915

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*SAFETY FIRST, IGOROT VARIETY 1046

An interesting example of how the modern Safety-First idea is used by an Igorot roadbuilder.
ENG. AND MIN. JOURN., Dec. 25, 1915

DETAILS OF PRACTICAL MINING 1047

*Compressed-Air Equalizing System at Copper Queen—Wash and Change Houses — *Runaway Tubs or Hutches—Resetting a Derailed Shovel.

DETAILS OF MILLING AND SMELTING 1050

*Handling Low-Grade Matte at Anyox, B. C.—Baggaley Patent for Utilizing Heat of Molten Slag—*Cement Gun for Boiler Setting—Making Babbit Castings—*Soft Metal Hammer.

PHOTOGRAPHS OF THE YUKON GOLD CO.'S OPERATION 1052

CORRESPONDENCE AND DISCUSSION 1054

The Mexican Mining Law—Fineness of Ore Crushing for Assaying—Steel Shaft Timbering—Concentration Formulas.

*THE CLIFTON-MORENCI STRIKE 1055

A short description of the strike situation in Arizona, illustrated by several photographs showing some incidents connected with the attempt of the Western Federation of Miners to obtain a foothold in Clifton-Morenci and Metcalf. The mining companies have adopted the unusual method of caring for loyal employees in a refugee colony outside the strike area until work can be resumed; some views are shown of this new tent colony, locally called "Spotless Town." It is at Duncan, Ariz., about 40 mi. from Clifton.
ENG. AND MIN. JOURN., Dec. 25, 1915

COPPER IN GERMANY 1057

An analysis by Gilbert Hirsch, of the New York "Evening Post," of the copper situation in Germany. He states that there is no danger of a copper shortage there. In addition he gives some interesting details of visits to various German mines.
ENG. AND MIN. JOURN., Dec. 25, 1915

WASHINGTON MEETING OF THE M. M. S. A. 1059

Under the auspices of the Mining and Metallurgical Society of America a meeting of all the mining societies of the United States was held in Washington on Dec. 16 to urge upon Congress the desire of the mining industry that the mining laws be revised. A remarkable unanimity of opinion was exhibited at this meeting. This article is a summary of the proceedings.
ENG. AND MIN. JOURN., Dec. 25, 1915

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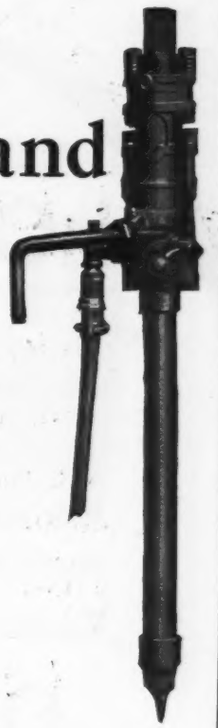

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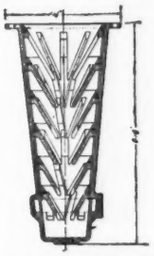

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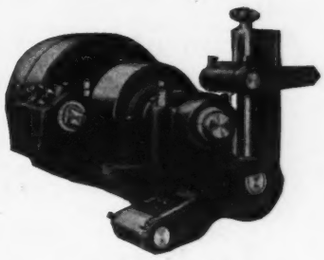

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Repeat orders for 381 Simplex Sand Tables
" " " 156 " Slime Tables
" " " 736 Cone Baffle Classifiers
have been received by us during the last 15 months.

The Miami Copper Co. of Miami, Arizona, has recently given us the orders for 42 Double-Deck Tables and 83 Classifiers.

The Inspiration Con. Copper Co.'s new plant at Miami, Arizona, is being equipped with 234 Double-Deck Simplex Tables and 400 of our Classifiers.

DEISTER MACHINE COMPANY

INCORPORATED JULY, 1912

Home Office and Factory:—1933-2003 East Wayne Street, FORT WAYNE, IND., U. S. A.
London Office:— No. 1, London Wall Bldgs. LONDON WALL, E. C.

AGENTS

WILLIAM L. REEDER	410 Consolidated Building	JOHANNESBURG, SO. AFRICA
TAKATA & COMPANY	2 Yeiraku-cho, Nichome, Kojimachi-ku	TOKYO, JAPAN

EMPIRE NEW YORK ENGINEERING CO., EMPIRE

Quick Shipments

Quick shipment of your dredge means the early commencement of dividends. We can design, build and ship an EMPIRE Gold-Dredge in less time than will be required by any other manufactory. Our Engineering Department studies the conditions and produces the plans in the minimum of time. Our location, in the center of production of raw materials, eliminates delay and minimizes costs. No matter how large and diversified the equipment, our experience and our resources enable us to lay it down on your property, erect and put it in operation, with a promptness that means an earlier realization on the investment.

Send for the two Empire text-books: Gold-Dredges and Prospecting Drills.

Empire Placer - Mining Equipment

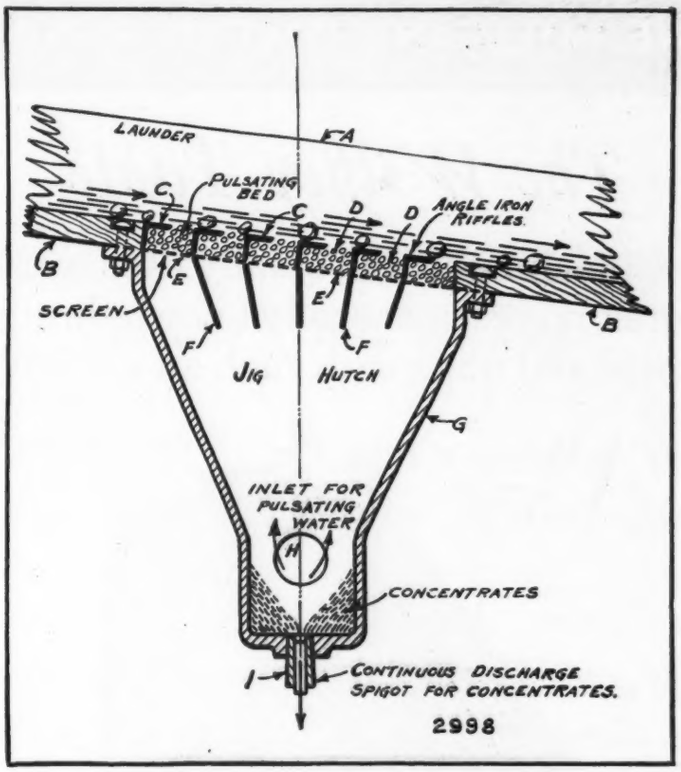
Includes Dredges, Drills, Hydraulic or Bucket Gravel-Elevators, High-Carbon Steel Sluices and Riffles, Hydraulic Pipe-Lines, Giants, Etc. We design and build your equipment to suit your conditions.

V. A. STOUT, Western Representative, Room 601 Balboa Building, SAN FRANCISCO

NEW YORK ENGINEERING COMPANY

2-RECTOR STREET,- NEW YORK

A Greater Saving of Gold



Richards Pulsator Riffle

You know the waste caused by a "packed" riffle in placer mining.

You know the trouble and loss of time caused by the ordinary "clean-up."

The Richards Pulsator Riffle eliminates both of these "bug-bears."

It is automatic and continuous in discharge. Not a chance for "packing." This is due to the application of an intermittent pulsating current of water.

There is no necessity for closing down the dredge or hindering operation in any way when the Richards Riffle is cleaned. The trouble and loss of time caused by the ordinary "clean-up" is entirely eliminated.

Think of the saving in gold if you never have "packed" riffles! Think of the increased output if you don't have to shut down for "clean-up."

Other features too combine in making the Richards Pulsator Riffle a machine that will best meet your conditions.

Bulletin No. 1073 gives complete details. Shall we send you a copy?

The Denver Engineering Works Co.

Denver **Colorado**

ALSO MAKERS OF

Richards Pulsator Jigs
Ovoca Classifiers
Isbell Concentrators
Electric Hoists

Mine Timber Framing Machinery
Ore Crushers
Automatic Samplers

D & W Ball Mills
Crushing Rolls
Mine Cages
Stamp Mills

Revolving Screens and Grizzlies
Sample Grinders
Dewco Tube Mills

"HEADQUARTERS"

FOR MINE MILL AND SMELTER SUPPLIES

The Wilfley Table

There is no machine so universally used in the concentration of ores, none so generally known throughout the mining world and none with such an enviable record.

A WILFLEY IN ACTION

Note the perfect separation between the several minerals and the waste.

In selecting a Wilfley Table for your concentration problem you confirm the judgment of thousands of operators who have made a success in their line.

Send for bulletins

M&S Co

THE MINE & SMELTER SUPPLY COMPANY

DENVER SALT LAKE CITY EL PASO

NEW YORK OFFICE: 42 BROADWAY

The Wedge Mechanical Furnace

Patented

Knowing How, Commercially Applied, Means Profit To You

REMEMBER, we build roasters of different types and detail to produce different conditions required.

Over twenty years' practical experience, not only in building furnaces, but operating as well, enables us to deliver furnaces that give the desired results at low operating cost.

Write us, stating analysis of ore, concentrates, mixture or material you desire to roast, characteristics and physical condition of same, number of tons to be treated per twenty-four hours, and results desired in the calcine.

Wedge Mechanical Furnace Company

Greenwich Point, Philadelphia

Large Regular Sized Pieces

of carbide are the most economical to use, and produce the best results in Miners' lamps, because the generation of gas is slower. It is more uniform in volume, of more even pressure and does not overheat the lamp.

Miners' Carbolite

consists of large, regular-sized pieces; contains no "fines" or dust—in fact, it is made especially for Acetylene Mine Lamps.

Being free from dust and fine material, there is no excess of gas, no waste and no clogging of the burner. Each charge lasts longer, because with regular sized pieces the gas generates more uniformly and all of the carbide is used.

MINERS' CARBOLITE is pure calcium carbide, made from the best and purest raw materials we can secure, and is guaranteed to produce the highest average gas yield.

Packed in 100 lb. and 25 lb. drums; 2 lb. and 10 lb. cans.

Write us for further information, prices and distributing points.

American Carbolite Sales Company

Warehouses in principal cities

Duluth, Minn.

Carbolite **is the trade name for superior carbide.**

AIR COMPRESSORS

At the present time compressed air is used in almost every art known to man and as its use is dependent so much upon its economic production the selection of compressor equipment is of very prime importance.

Ingersoll-Rand Compressors embody every feature that will contribute in any way toward producing air at the lowest cost. Our experience in compressor building has been so extensive that it qualifies us as the leader in this line of manufacture, and has enabled us to place before the buyer a line of machines that will meet his every need efficiently and economically.

A few Ingersoll-Rand commendable features are automatic lubrication and regulation, enclosed dirt-and-dust-proof construction, thorough intercooling and waterjacketing, superb valve movements and compactness—

The line ranges in capacities from 3 to 60,000 cubic feet—all pressures to 3,000 lbs.

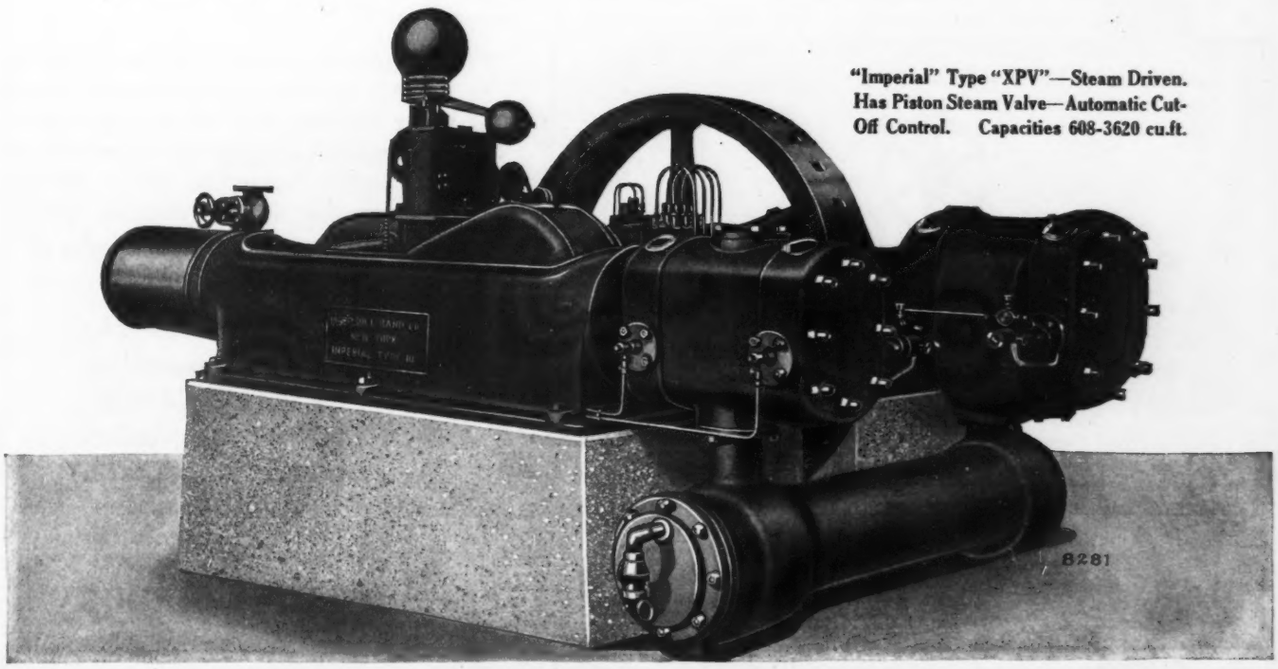
All conditions of drive can be met.

Ask for the Bulletins.

INGERSOLL-RAND COMPANY

NEW YORK Offices the World Over **LONDON**

150-C



"Imperial" Type "XPV"—Steam Driven. Has Piston Steam Valve—Automatic Cut-Off Control. Capacities 608-3620 cu.ft.

Hoist Accidents Rank Fourth In Mine Accident Causes—

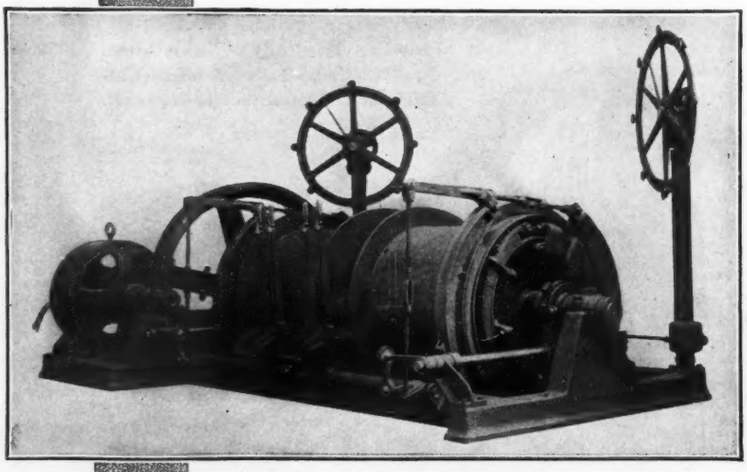
Statistics show that the causes of mine accidents in the United States rank, (1) Falls of rock; (2) Explosions; (3) Falls of persons; (4) Hoist accidents.

In other words, of all mechanical equipment, hoists are the most prolific cause of accidents.

The first (3) causes are largely impossible of control. The fourth is possible of control. Choose the hoist which reduces possibility of hoist mishaps to a minimum.

WELLMAN-SEAVER-MORGAN

Now that compensation laws are becoming prevalent, it is absolutely necessary that hoists be chosen on a disregard of first cost—with an eye to **service** and **safety.**



Electric Hoist of Smuggler Leasing Co., Aspen, Colo.

The higher cost of WELLMAN-SEAVER MORGAN Hoists is a necessary result of their greater cost of manufacture. The margin of difference in price represents better material, more careful design, ample safety devices which anticipate every contingency of peril.

Put your mine into the "safe" class by specifying WELLMAN-SEAVER-MORGAN for your hoisting service. Investigate.

The Wellman-Seaver-Morgan Company
Cleveland, Ohio, U. S. A.

THE DENVER "DREADNAUGHT" DRILLS

DAILY DEMONSTRATE THEIR SUPERIORITY IN MINE, TUNNEL AND OPEN WORK

Model 60 Denver "Dreadnaught" Drills in an advance heading of the Rogers Pass Tunnel. These drills have replaced all other makes in the main headings of this work and were adopted by Foley Bros., Welch and Stewart because they demonstrated their superiority in actual service. After adopting them they made their record month's progress.

This is only one of many instances where they have proven their greater speed and reliability over other and heavier types under the most exacting conditions.

A refinement of design combined with the sort of material and workmanship that made the "Waugh" Drills famous has produced in the "Dreadnaught" the "ideal" type of rock drill.

ROCK DENVER DRILLS

Write for Bulletin E-60.

"WAUGH" STOPERS "CLARK" AIR METERS

The Denver Rock Drill Manufacturing Co.

DENVER, COLO.

225 Rialto Bldg., San Francisco, Cal.
301 San Francisco Street, El Paso, Tex.
508 First Avenue South, Seattle, Wash.
34 Queen Street, Melbourne, Australia.

30 Church Street, New York City
115 W. 2nd South Street, Salt Lake City, Utah
Houghton, Mich.
Royal Chambers, Johannesburg, South Africa

E-3

Distinctive Features Of Traylor Gyratory Crushers

The main shaft and bearings are much larger and suspended at point of least motion.

The hopper and spider can be removed independently, *i.e.* without interfering with any other part.

The concaves can be replaced without removing the spider, main shaft, crushing head or hopper.

Positive lubricating apparatus.

The most accessible crusher on the market for making repairs.

The only gyratory crusher that has all the best features found in others, combined with our "distinctive design."

Our G-2 Catalog Gives Complete Details.

Traylor Eng. & Mfg. Co.
Allentown, Pa.
U. S. A.

Eastern Office, 30 Church St., N. Y.
Western Office, Salt Lake City, Utah

The Best American Practice

involves the process of crushing, classification and separation combined to give the highest return warranted by the cost of operating and the handling of large tonnages.

Many machines are required, each operated according to its own range of feed or product.

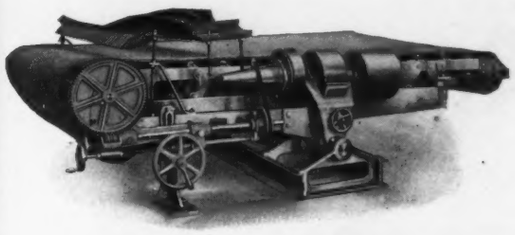
It is realized by all successful concentration engineers that no single machine or single operation will bring economic results.

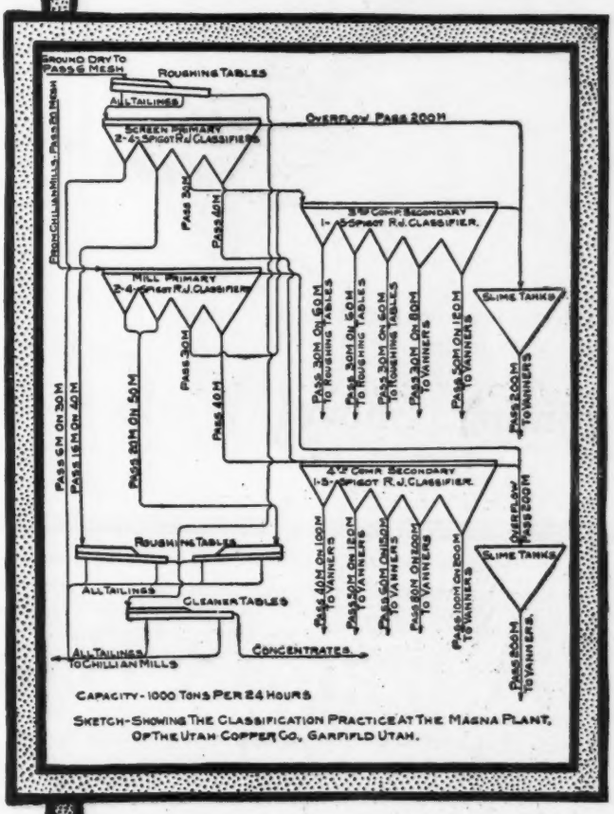
The best machinery in the modern mill is that developed in the growth of concentration practice, or from that used in other industries; in this development the Allis-Chalmers Mfg. Company has been a large factor, due to its ability to apply field experience to the perfecting of designs.

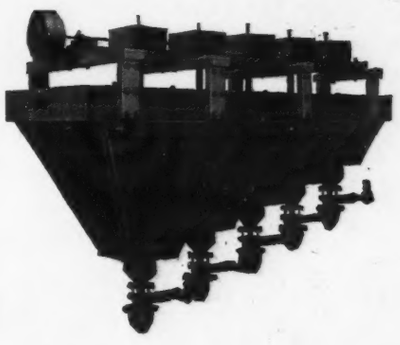
Operating mill men, having extended experience with Allis-Chalmers Crushers and Handling Equipment, Rolls and Regrinders, Sizers and Concentrators, Transmission and Power Machinery recognize that its high reputation is based upon reliability and economy under severe service conditions.

Backed by this reputation the Allis-Chalmers Mfg. Company is particularly fitted to furnish the entire equipment of modern concentration plants, all from its own shops.

Some of its successful modern machines are the Hancock Jig, the Richards and Richards-Janney Classifiers, the Anaconda Rolls, the Isbell Vanner. Each is a distinct advance that makes for economy under present-day heavy tonnage conditions.




GROUND DRY TO PASS 6 MESH
ROUGHING TABLES
ALL TAILINGS
OVERFLOW PASS 200M
SCREEN PRIMARY
2-6 SPIGOT R.J. CLASSIFIERS
FROM CHILLIAN MILLS - PASS 20 MESH
PASS 30M
PASS 40M
3 1/2 COMP. SECONDARY
1-6 SPIGOT R.J. CLASSIFIER.
MILL PRIMARY
2-4 SPIGOT R.J. CLASSIFIER
PASS 30M ON 50M TO ROUGHING TABLES
PASS 30M ON 50M TO ROUGHING TABLES
PASS 30M ON 60M TO ROUGHING TABLES
PASS 30M ON 80M TO VANNERS
PASS 50M ON 150M TO VANNERS
SLIME TANKS
PASS 200M TO VANNERS
PASS 6M ON 30M
PASS 16M ON 40M
PASS 20M ON 50M
PASS 30M
PASS 40M
4 1/2 COMP. SECONDARY
1-5 SPIGOT R.J. CLASSIFIER.
ROUGHING TABLES
ALL TAILINGS
CLEANER TABLES
ALL TAILINGS TO CHILLIAN MILLS
CONCENTRATES
PASS 40M ON 100M TO VANNERS
PASS 50M ON 150M TO VANNERS
PASS 50M ON 150M TO VANNERS
PASS 80M ON 200M TO VANNERS
PASS 100M ON 200M TO VANNERS
OVERFLOW PASS 200M
SLIME TANKS
PASS 200M TO VANNERS
CAPACITY - 1000 TONS PER 24 HOURS
SKETCH - SHOWING THE CLASSIFICATION PRACTICE AT THE MAGNA PLANT, OF THE UTAH COPPER CO., GARFIELD UTAH.



Allis-Chalmers Mfg. Company

Mining Machinery Department : Milwaukee, Wis.

Be Cold Blooded

We can prove our contention to your satisfaction and profit. May we?

Wyoming Shovel Works
Wyoming Pa.

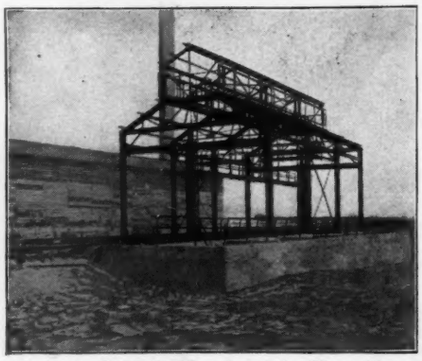
Apply the same cool judgment on your next shovel purchase that you used in putting through that big business deal. Sentiment, prejudice, all such are beside the point when the purchase of 100 shovels always involves over $5,000 worth of pay roll. We don't pretend to reduce the cost of shovels—we reduce the cost of shovelling, and **that's** where the money's saved.

WYOMING-MAYARI
RED EDGE
SHOVELS

Mayari Chrome Nickel Steel heat treated blades. Extra selected XX second growth northern white ash handles. Put together to stay together. Ask us for "Scientific Shovelling" and a catalog. Both are here for you and both worth having.

AMERICAN BRIDGE COMPANY
HUDSON TERMINAL-30 CHURCH STREET, NEW YORK

Manufacturers of Steel Structures of all classes particularly **BRIDGES AND BUILDINGS**



Coal Handling Station, for Coke Plant, New Duluth, Minn.

SALES OFFICES

NEW YORK, N. Y., 30 Church Street
Philadelphia, Pa., . Widener Building
Boston, Mass. . . John Hancock Bldg.
Baltimore, Md., Continental Trust Bldg.
PITTSBURGH, PA. . . Frick Building
Rochester, N. Y. . . . Powers Block
Buffalo, N. Y. . Marine National Bank
Cincinnati, Ohio. Union Trust Building
Atlanta, Ga. . . . Candler Building
Cleveland, Ohio . Rockefeller Building
Detroit, Mich., Beecher Ave. & M. C. R. R.
CHICAGO, ILL., 208 South La Salle St.
St. Louis, Mo., Third Nat'l Bank Bldg.
Denver, Colo., First Nat'l Bank Building
Salt Lake City, Utah, Walker Bank Bldg.
Duluth, Minn. . . . . Wolvin Building
Minneapolis, Minn., 7th Ave. & 2nd St., S. E.

Pacific Coast Representative:
U. S. Steel Products Co. Pacific Coast Dept.
SAN FRANCISCO, CAL., Rialto Building
Portland, Ore. . . . . Selling Building
Seattle, Wash., 4th Ave. So. Cor. Conn. St.

Export Representative:
United States Steel Products Co., 30 Church St., N. Y.

On the Job

Where dependable drills and bits are required—where the work has been held back on account of drills being laid up for repairs—both operator and owner will welcome the

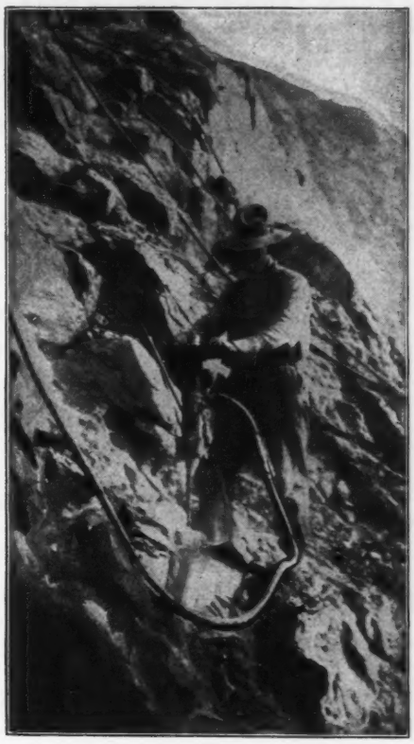
No. 20 "Wonder" Drill

It is a 30-lb. machine, fitted with "D" piston. For down-holes only, uses 7" hexagon hollow drill bits and is a very rapid cutter. This is but one of our many types and sizes of drills whose efficiency have been proved.

Hardsocg "Wonder" Drills will mean more feet of holes per dollar spent.

Write for complete details and prices.

Hardsocg Wonder Drill Co.
Ottumwa, Iowa



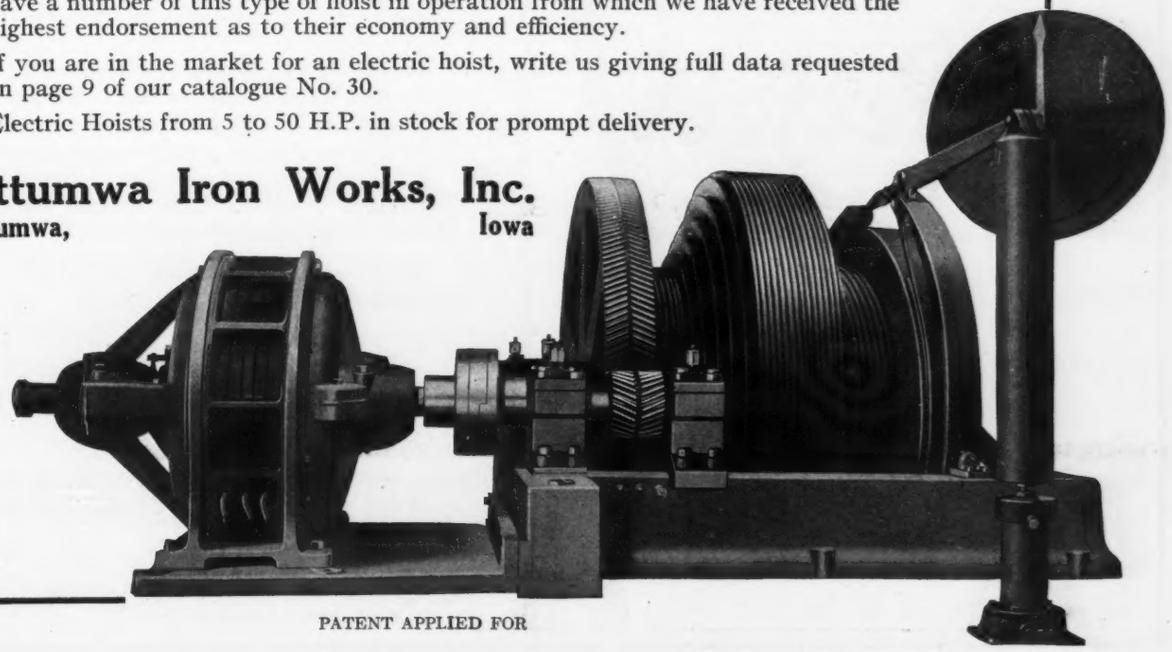
OTTUMWA High Efficiency Electric Hoists

You can reduce your power cost by this design of Electric Hoist. It also reduces first cost by making possible a smaller motor, consequently reducing the maximum demand charge. The brake is operated by oil under pressure, and is equipped with overwinding device, and automatic emergency application. We have a number of this type of hoist in operation from which we have received the highest endorsement as to their economy and efficiency.

If you are in the market for an electric hoist, write us giving full data requested on page 9 of our catalogue No. 30.

Electric Hoists from 5 to 50 H.P. in stock for prompt delivery.

Ottumwa Iron Works, Inc.
Ottumwa, Iowa



PATENT APPLIED FOR

1860

COLORADO IRON WORKS COMPANY

ORE SMELTING EQUIPMENTS

ORE MILLING MACHINERY

1915

Among many others, The Butte & Superior Copper Co. has ordered a

Portland Filter

To replace other filters for

Dewatering Flotation Concentrates.

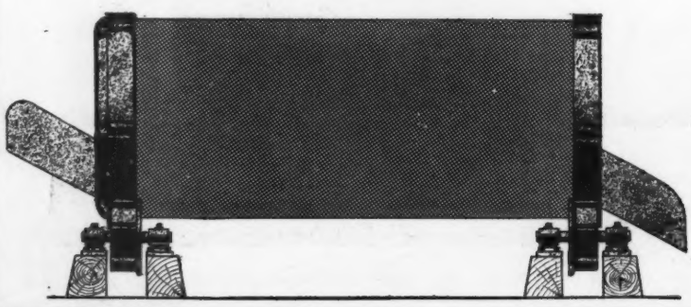
Watch the Portland Filter!

Colorado Iron Works Co.

Established 1860 **Denver, Colorado, U. S. A.**

"Perfect"

Wire Cloth Screens keep the Screening Machine running continuously.



A Screening Machine Can be No Better than its Screen

A screening machine is doing just what it is made to do only when it operates continuously. Continuous operation is profitable operation. Get continuous operation by installing screens of "Perfect" Double Crimp Wire Cloth. This screen cloth eliminates frequent shutdowns for change of screens that have broken or whose openings have become irregular. The mesh of Perfect Wire Cloth is always the same. The double crimp keeps it so.

Keep your screening machines running all the time.

Write now for sample of this cloth and copy of the Perfect Screening Book. Both free.

The Ludlow-Saylor Wire Co.

General Office and Factory, St. Louis, Mo.

Branch Offices—20 East Jackson Blvd., Chicago. Mills Bldg., El Paso, Texas. Box 804, Salt Lake City, Utah.

Braun Universal Laboratory Sampler

For accurately and impartially sampling *dry material*—*chemicals* in pulverized or crystal form, *ores, coke, coal, grains, fertilizers* and similar material

The prominent features are—

The separators do not have to be removed for cleaning—

It is practically dust proof—

It is thoroughly and quickly cleaned—

It delivers an accurate and impartial sample not obtainable by hand sampling—

It eliminates the personal equation.

Shipping Weight 220 lbs. • Price, net, $100.00.
Ask for Catalog 50 E.

BRAUN-KNECHT-HEIMANN-CO. — THE BRAUN CORPORATION

San Francisco, U. S. A. **Los Angeles, U. S. A.**

Manufacturers of Laboratory Labor-Saving Machinery
Specialists in Laboratory Equipment and Testing Apparatus
Dealers in Laboratory Glassware and Chemicals

Fifty

Cents

Rock Dust Can't Hurt Him

He wears a **Pulmosan Respirator.** No rock dust can get past the multi-screening materials, each supplementing the other like succeeding lines of entanglements and trenches. Each deadly particle, even the very finest, is caught and held.

No miner's consumption for **this** man. He's strong and well; a productive unit on the company's payroll instead of a charitable drag.

The Pulmosan Respirator
"Not Made of Metal or Rubber"

should be used to protect **your** men. A single trial convinces. It's the lightest in weight, smallest in size, coolest and most comfortable to wear and **lowest in cost.** Three **Pulmosan** Respirators for the price of one of the ordinary kind, not nearly so efficient.

The proposition is worth trying and the cost of the experiment is trifling.

Multi-Metal Separating Screen Co.
Manufacturers of Testing Sieves and Mining Screens of Highest Potentiality from 10 Mesh to 350 Mesh.
76 East 131 Street **New York City**

Clip This Coupon

12-25-15

Multi-Metal Separating Screen Co., 76. E. 131st St., New York City.
Send me you Pulmosan Respirator Booklet.

Send me.....(?) Respirators. (Indicate how many.)

Name.....

Address.....

.....

Air Compressors

We have the following air compressors in Denver ready for immediate shipment. These compressors are in practically as good condition as when new. Most of them have not been in use six months. You can save 50% over the cost of new.

NORWALK COMPRESSORS

14x26 steam, 22x13 air, 24 stroke, capacity 1,160 feet, Corliss valve on low pressure steam.
14x16x9½x16 compound air simple steam, capacity 558.
10x12x6¾x12 compound air simple steam, capacity 282.
We have three of this size.

INGERSOLL-RAND COMPRESSORS

8x10x12 Rand, Class C, capacity 153 feet.
14x14x22 Rand, Class C, capacity 391 feet.
14x16x22 Rand, Class C, capacity 512 feet.
16x18x24 Rand, class C, capacity 671 feet.
9½ and 12x8½ and 12x12 Rand, Class B3, comp. air and steam, capacity 282 feet.
11 and 18x18½x10½x10 Ingersoll, Class G2, comp. air and steam, capacity 439 feet.
24 and 14x24 and 13x16 Rand Imperial Type 10, comp. air and steam capacity 1250 feet.

LAIDLAW-DUNN-GORDON COMPRESSORS

6x8x6 simple steam and air comp., 52 feet capacity.
8x14½x8x8 duplex steam comp. air, capacity 345 feet.
12 and 20x11x12 duplex steam comp. air, capacity 520 feet.
10x18x10x10 duplex steam comp. air, capacity 588 feet.

LEYNER COMPRESSORS

8x9x12 simple steam and air, capacity 130 feet.
12x13½ and 8½x16 comp. air simple steam, capacity 314 feet.
16x18 and 11x22 comp. air simple steam, capacity 648 feet.

FRANKLIN COMPRESSORS

9x11x11simple steam and air comp., capacity 193 feet.
10x12x12 simple steam and air comp., capacity 236 feet.

AMERICAN COMPRESSOR

12x14x16 simple steam and air, capacity 342 feet.

BELTED COMPRESSORS

6x6 Curtis vertical duplex, capacity 48 feet.
10x12 Rand Imperial type 11, capacity 196 feet.
16 and 10x18 Leyner comp. air, capacity 481 feet.
10 and 10x12 Laidlaw comp. air, capacity 525 feet.
18 and 10x10 Clayton comp. air, capacity 588 feet
24¼ and 14¼x14 Ingersoll, Class J2, capacity 10,007 feet.

AIR RECEIVERS

2 48x10 6-inch opening, weight 2,350 lbs.
7 42x10 6-inch opening, weight 1,700 lbs.
1 42x12 6-inch opening, weight 2,000 lbs.
1 30x10 4-inch opening, weight 950 lbs.
2 24x6 2½-inch opening, weight 590 lbs.

AIR DRILLS

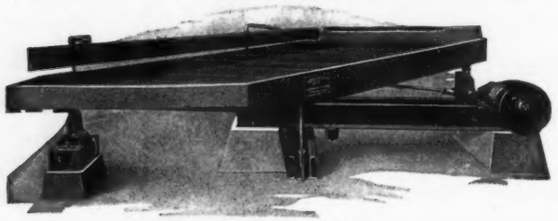
Every size and make of piston drills, $75.00 each.
40 new Murphy stoping drills, $50.00 each.
5 new Murphy sinking drills, $40.00 each.
Columns, arms, clamps, tripods, etc.

The Morse Bros. Machinery & Supply Co., Denver, Colorado

MANUFACTURERS OF

Deister and Overstrom Tables

In Either SINGLE or DOUBLE Deck Types



No. 5 Deister Sand Table.

Thousands of tables in use in all parts of the world.
It's not what we say of our products, it's what our customers say.
Test sheets and hundreds of testimonial letters from satisfied users.

Send your concentrating table problems to us and make use of our years of experience.

The Deister CONCENTRATOR Company

Office, Factory and Test Plant:

Fort Wayne, Indiana

Denver Office
1718-1720 California Street

San Francisco Office
75 Fremont Street

THE CASE Oil-Fired Furnace
One, Two or Three Muffles

The Case Improved

Oil-Fired Muffle Furnace (Front Control)

The *Latest Type of Assay* Furnace

A Dividend Payer
from the day it is installed

Carefully compiled records of results obtained together with the unqualified endorsements of enthusiastic purchasers in metallurgical fields everywhere, fully justify and substantiate our strongest claims for CASE OIL FURNACES.

CONSIDER THESE ADVANTAGES:

ECONOMY Utilization of all heat units in the oil through perfect combustion, gives lowest possible fuel consumption—saving 20 to 60% in fuel cost.

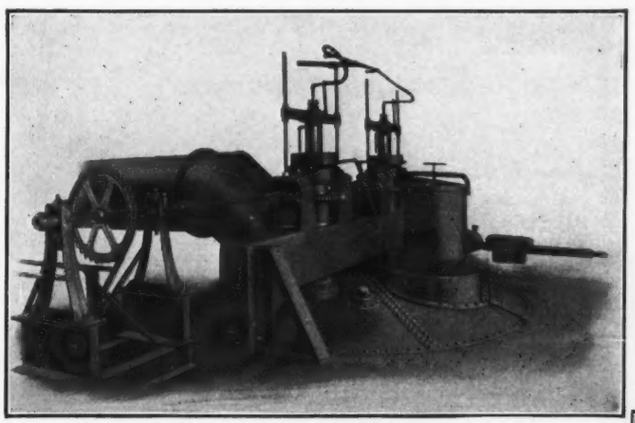
RAPIDITY Work **is** handled in the shortest possible time, muffles at fusion heat in 30 minutes. Puts "Speed" into the assay office.

EFFICIENCY By saving **fuel, time** and **labor** a **Case Oil Furnace** increases greatly the ratio of *results* accomplished to *energy* expended.

Write today for complete information and photograph.

The Denver Fire Clay Company

DENVER U. S. A. COLORADO



Stationary Section, with stirring gear.

Leading Smelter Plants

have adopted for their zinc smelting and roasting furnaces the

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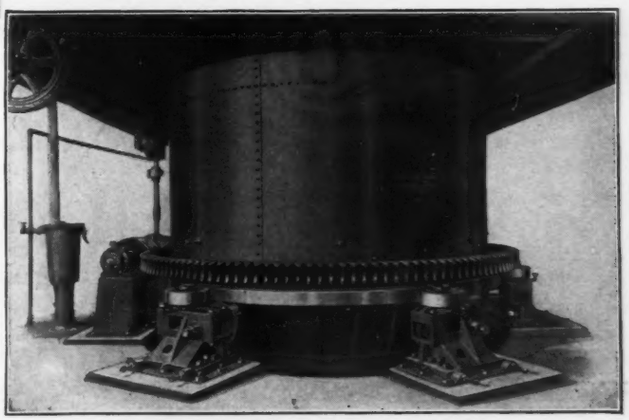

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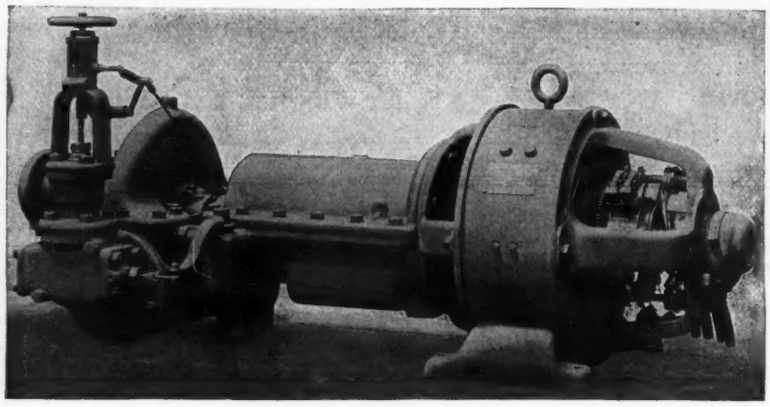

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The sets are very simple and are so designed and built that long life and thorough reliability are assured.

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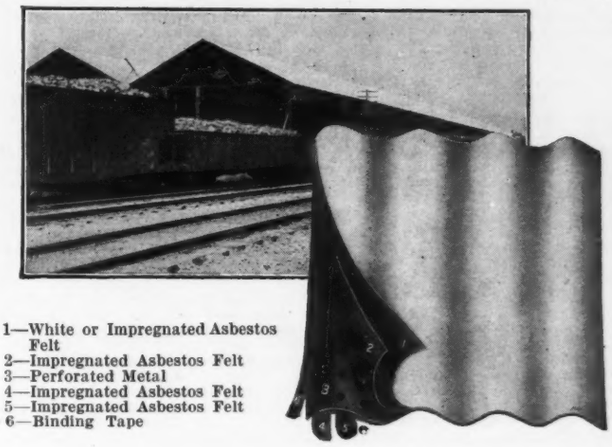

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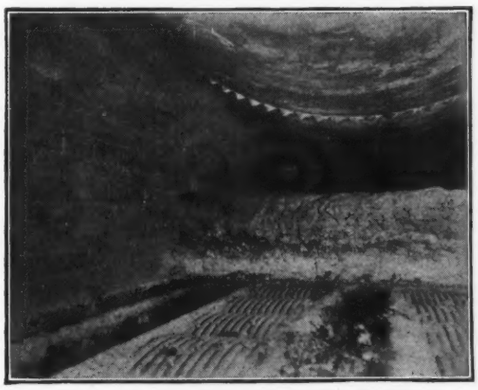

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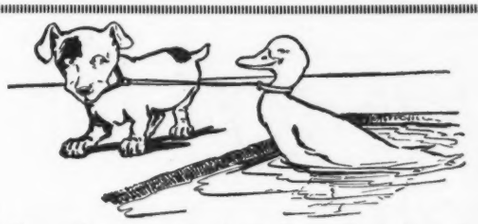

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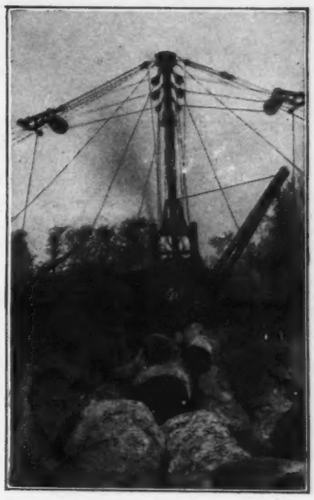

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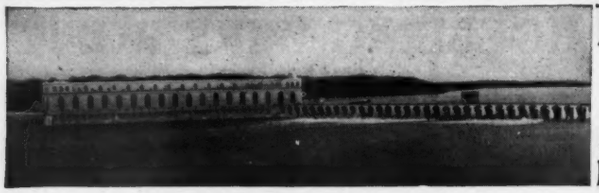

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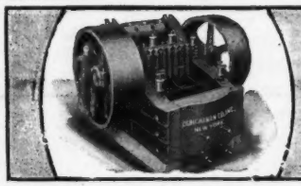

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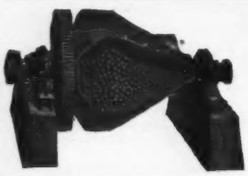

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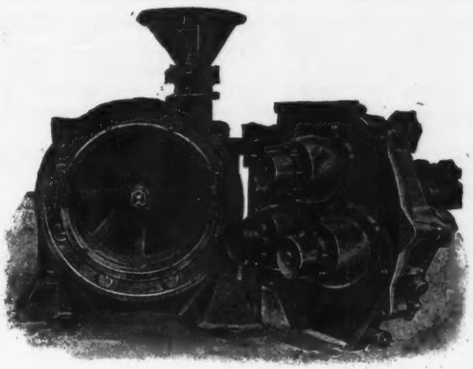

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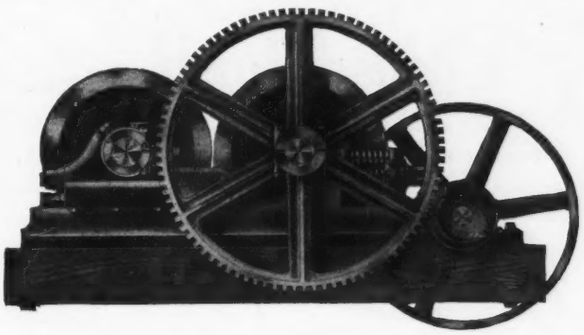

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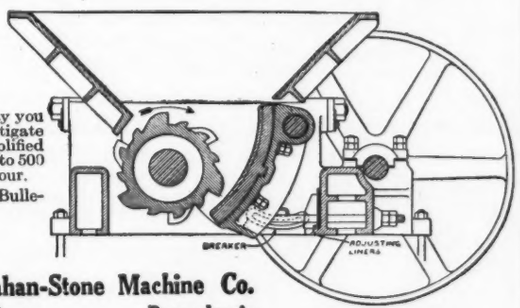

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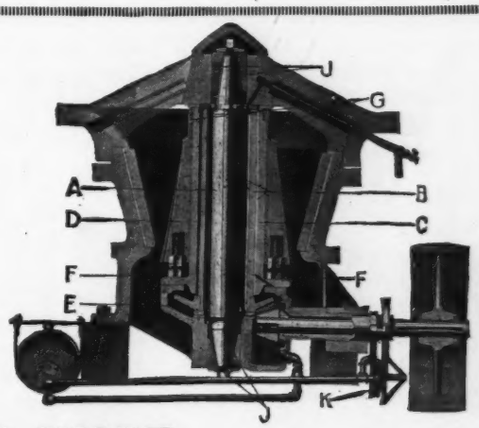

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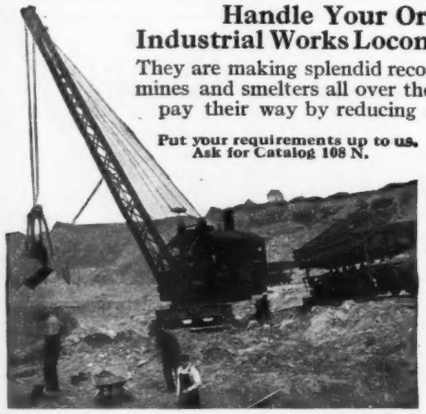

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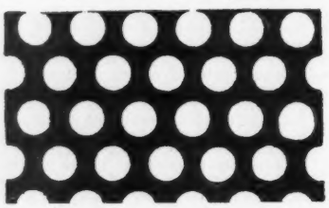

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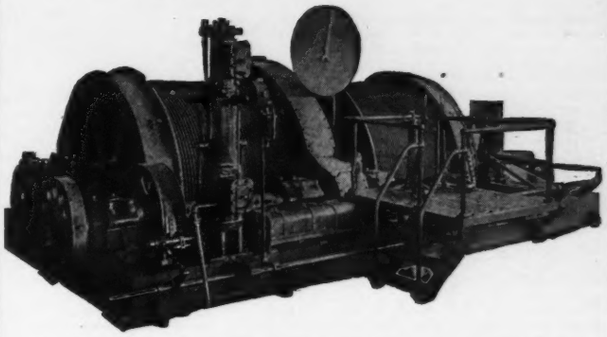

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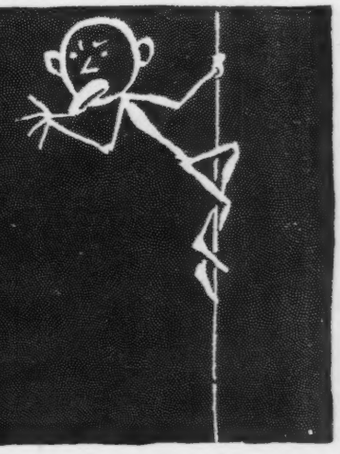

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Corliss tanden de doble presion, de doble àngulo, fuerzas por motor o correa, portàtiles, para galerias movidas por motor.

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Webster Mfg. Co., Tiffin, Ohio.

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Conductores Subterraneas
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Cubos para Elevadores
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Union Construction Co., San Francisco, Calif.
Yuba Construction Co., The, San Francisco, Cal.

Editores de Libros Tècnisos
McGraw-Hill Book Co., Inc., 239 West 39th St., New York. Sucursales: London and Berlin.

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Stephens-Adamson Mfg. Co., Aurora, Ill.
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Johns-Manville Co., H. W., New York.

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Johns-Manville Co., H. W., New York.

Ejemplares Minerales
Braun Corporation, The, Los Angeles, Calif.
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Braun-Knecht-Heimann Co., San Francisco, Cal.
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Johns-Manville Co., H. W., New York.

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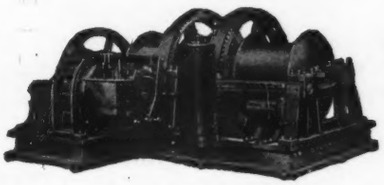

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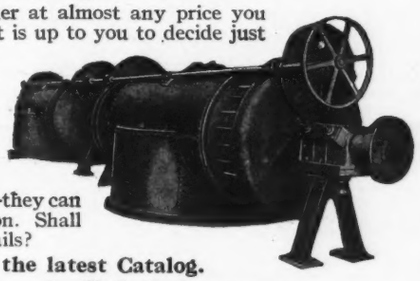

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"Smooth-On" Cemento de hierro que se metaliza y forma parte del metal al ser aplicado.

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En 10 tamaños de 5 a 7 hogares, 381 a 1,925 pies cuadrados de àrea de hogar.
Planchas de acero cilindricas contienen verticalmente superpuestos los Hogares. Por medio de brazos hurgadores operados desde el eje vertical, central, el mineral calcinandose pàsa dèsde el centro de la tapa de un hogar, baja a traves de los inferiores descargando desde el borde del mas bajo. El aire calentado para la combustion recorre hacia arriba.
Morse Bros. Mach. & Supply Co., Denver, Colo.
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Varios tamaños en deposito, nùmeros de hogares y àreas de hogares Los hogares se hallan colocados los unos sobre los otros vertical mente, todos encerrados dentro de cubiertas adecuadas. El eje vertical gira en el centro rastrillando el mineral en los hornos, por medio de hurgadores y dientes sujetos a los brazos. El Mineral recorre a traves de la estufa dèsde el borde al fondo. Para corregir las desigualdades en la alimentacion de calor, los gases en combustion pasan a traves de las càmaras caloriferas intermedias de los hogares as ì como tambien en los mismos hogares. Cajas de fuego externas se comunican con las càmaras caloriferas, por medio de humeros. El eje central esta diseñado para ser accesibles. Pidanos catàlogos.

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Lietz Co., The A., San Francisco, Calif.

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Milburn Co., The Alexander, Baltimore, Md.
Simmons Co., John, 110 Center St., New York.
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Wolf Safety Lamp Co., 74 Wash. St., New York.

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Johns-Manville Co., H. W., New York.

Laves de Boca de Lagarto
Roebling's Sons Co., John A., Trenton, N. J.

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Vulcan Iron Works, Wilkes-Barre, Penn.
Whitcomb Co., Geo. D., Rochelle, Ill.

Locomotoras a Vapor
Porter Co., H. K., 410 Wood St., Pittsburgh, Penn.
Sucursale: 30 Church St., New York.
Vulcan Iron Works, Wilkes-Barre, Penn.

Locomotoras de Aire Comprimido
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Locomotoras Elèctricas por Acumuladores
Atlas Car & Mfg. Co., Cleveland, Ohio.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

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De todos tamaños.
Existencias en almacen de sencillas y alambradas.
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Morse Bros. Mach. & Supply Co., Denver, Colo.

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Màquinas a Petroleo Crudo
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Sturtevant Mill Co., Boston, Mass.

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La "Isbell' 'toma la alimentacion sin clasificar.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Cardas concentradoras.
James Ore Concentrator Co., Newark, N. J.
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American Zinc, Lead & Smelting Co., 55 Congress St., Boston, Mass.
Balbach Smelting & Refining Co., Newark, N. J.
Bartlesville Zinc Co., 52 Broadway, New York.
Beer, Sondheimer & Co., 61 Broadway, New York.
Sucursal: 1101 New House Bldg., Salt Lake City, Utah.
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Consolidated Mining & Smelting Co. of Canada, Ltd., The, Trail, British Columbia.
Consolidated Ores Co., Boston Bldg., Salt Lake City, Utah. Eastern Office: 60 Broadway, New York.
Ducktown Sulphur, Copper & Iron Co., Ltd., Isabella, Tenn.
Edgar Zinc Co., Boatmen's Bank Bldg., St. Louis, Mo. Western Ore Purchasing Agent: David Taylor, Boston Bldg., Salt Lake City, Utah.
Granby Mining & Smelting Co., Suite 1710, Third National Bang Bldg., St. Louis, Mo.
Agente: Robert W. Conklin, 165 Broadway, New York, N. Y.
Hegeler Zinc Co., The, Danville, Ill.
Illinois Zinc Co., Peru, Ill.
International Smelting Co., 42 Broadway, New York. Ore Purchasing Department, 621 Kearns Bldg., Salt Lake City, Utah. Smelting Works, International, Utah, and Miami, Ariz. Refineries, Raritan Copper Works, Perth Arboy, N. J.; International Lead Refining Co., East Chicago, Ind.
Irvington Smelting & Refining Works, Irvington, N. J. Oficina sucursal, New York.
Matthiessen & Hegeler Zinc Co., La Salle, Ill.
Nichols Copper Co., 25 Broad St., New York.
Vèa el anuncio.
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Pennsylvania Smelting Co., Pittsburgh, Penn.
Phelps, Dodge & Co., New York City.
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The Slogan of the Cameron—"Character: The Grandest Thing"

Withstands the Wear of Gritty Water
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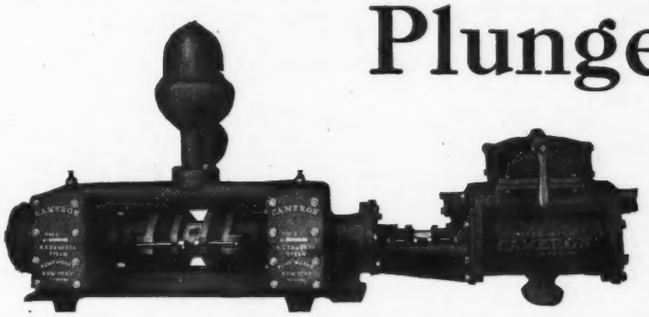

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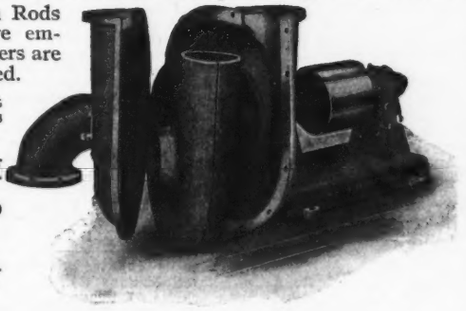

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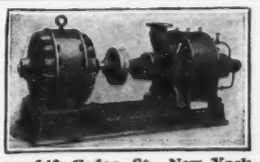

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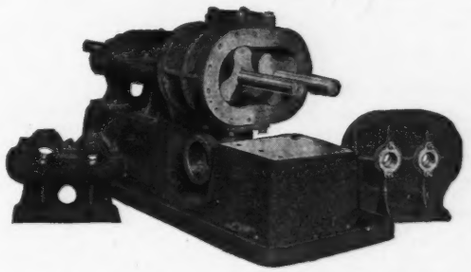

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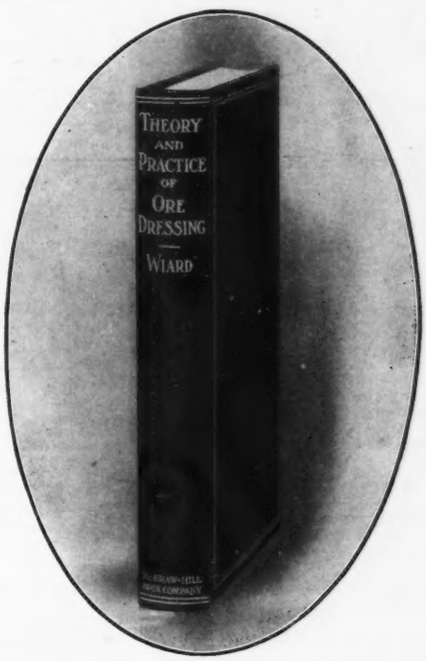

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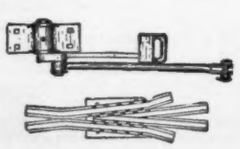
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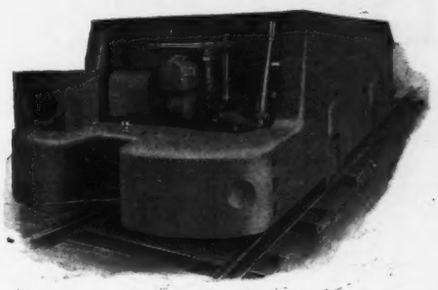

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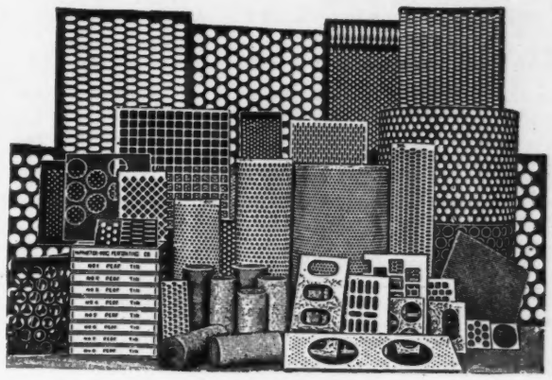

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Wood Drill Works, Paterson, N. J.
Nine sizes.

Drills, Prospecting
Ingersoll-Rand Co., 11 Broadway, New York.
New York Eng. Co., 2 Rector St., New York.
Rotation, sinking of casing, recovery of material accomplished at same time with "Empire."
Sullivan Machinery Co., Chicago, Ill., U. S. A.

Dryers, Ore
American Process Co., 68 William St., New York.
Especially designed and built for all materials.
Morse Bros. Mach. & Supply Co., Denver, Colo.

Dust Protectors (See Respirators)

Elbows, Pipe
Jefferson Union Co., Lexington, Mass.

Elevators, Bucket
Stephens-Adamson Mfg. Co., Aurora, Ill.
See advertisement on inside front cover for branch office addresses.
Webster Mfg. Co., Tiffin, Ohio.

Employees
Business Men's Clearing House, Denver, Colo.
Mechanics, mill men—sent to all parts of world.
Mines Technical Agency, Washington Bldg., Los Angeles, Calif.
Managers, engineers, millmen furnished.

Engines, Gas and Gasoline
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Morse Bros. Mach. & Supply Co., Denver, Colo.

Engines, Oil
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Ingersoll-Rand Co., 11 Broadway, New York.
Lyons-Atlas Co., Indianapolis, Ind., U. S. A.
Diesel. Vertical, 4-cycle units, 300 to 1,000 hp. Self-contained power plant, operating on crude oil. Saves space by eliminating boiler plants.
Morse Bros. Mach. & Supply Co., Denver, Colo.
National Transit Co., Oil City, Penn.
Nordberg Mfg. Co., Milwaukee, Wis.

Engines, Steam
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Morse Bros. Mach. & Supply Co., Denver, Colo.

Exhausters
Connersville Blower Co., The, Connersville, Ind.
Morse Bros. Mach. & Supply Co., Denver, Colo.

Extinguishers, Fire
Johns-Manville Co., H. W., New York.

Feeders, Ore
Stephens-Adamson Mfg. Co., Aurora, Ill.
"S-A" steel apron feeder; also rotary, reciprocating, grizzly, etc.
See inside cover for branch office addresses.
Webster Mfg. Co., Tiffin, Ohio.

Filter Bags
Filter Fabrics Co., Salt Lake City, Utah.

Filter Cloth, Metallic
Sweetland Filter Press Co., Singer Bldg., N. Y.

Filters
Colorado Iron Works Co., Denver, Colo.
"Portland" continuous revolving drum. For cyanide slimes, flotation concentrates, etc.
Kelly Filter Press Co., Salt Lake City, Utah.
Moore Filter Co., 115 Broadway, New York.
Vacuum process.
Oliver Continuous Filter Co., San Francisco, Cal.
Sizes 5 to 200 tons per day.
Automatic. For cyanide slimes, clay, salt, bicarbonate soda, and for dewatering flotation concentrate.
Sweetland Filter Press Co., Singer Bldg., N. Y.
Pressure leaf type. Convenient to operate.

Fire Forcing Presses
Wood & Co., R. D., Philadelphia, Penn.

Flange Presses
Wood & Co., R. D., Philadelphia, Penn.

Flanges, Pipe
Jefferson Union Co., Lexington, Mass.
Sizes 1 to 10 in. Two styles.
Designed for pressures up to 3000 lb.

Flotation Cell Bottoms
Filter Fabrics Co., Salt Lake City, Utah.

Flotation Oils
Pensacola Tar & Turpentine So., Gulf Point, Fla.

Flotation, Oil
Colorado Iron Works Co., Denver, Colo.
Portland filter for dewatering concentrates.
Minerals Separation American Syndicate (1913), Ltd.—Sole Agents: Beer, Sondheimer & Co., 61 Broadway, New York. Chief Engineer, E. H. Nutter, Merchants' Exchange Bldg., San Francisco.
Separates sulphide minerals from gangue.
Oliver Continuous Filter Co., San Francisco, Cal.
Dewaterer and dryer of flotation concentrate.

Forges
Denver Fire Clay Co., Denver, Colo., U. S. A.
Oil-fired for drill steel. Send for catalog.
Ingersoll-Rand Co., 11 Broadway, New York.
Monarch Eng. & Mfg. Co., Baltimore, Md.

Framers, Timber
Denver Engineering Works Co., Denver, Colo.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.

Frogs and Switches
Cincinnati Frog & Switch Co., Cincinnati, Ohio.

Furnaces, Assay
Braun Corporation, The, Los Angeles, Calif.
Braun-Knecht-Heimann Co., San Francisco, Calif.
Denver Fire Clay Co., Denver, Colo., U. S. A.
"Case" patent. One-, two- or three-muffle design unit system, low-pressure air.
Mine & Smelter Supply Co., The, Salt Lake City, Utah. Branches: Denver, El Paso, New York.
"Massco" oil-burning. Designed for small consumption of oil. Oxidizing or reducing atmosphere maintained by dampers.

Furnaces, Bullion Melting
Braun Corporation, The, Los Angeles, Calif.
Braun-Knecht-Heimann Co., San Francisco, Cal.
Denver Fire Clay Co., Denver, Colo., U. S. A.
"Case" patent. Oil-fired, low-pressure air, high temperatures quickly attained.
Send for catalog.
Monarch Engineering & Mfg. Co., Baltimore, Md.

Furnaces, Mechanical Roasting
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Dwight & Lloyd Sintering Co., Inc., N. Y. City.
General Chemical Co., Herreshoff Furnace Dept. B, 25 Broad St., New York, N. Y.
Ten sizes, 5 to 7 hearths, 381 to 1925 sq.ft. hearth area.
Cylindrical steel shell contains vertically superimposed hearths. By rabble arms operated from central vertical shaft, roasting ore travels from center of top hearth, down through lower ones, discharging from rim of lowest. Heated air for combustion travels upward.
Morse Bros. Mach. & Supply Co., Denver, Colo.
Wedge Mechanical Furnace Co., 115 Chestnut St., Philadelphia.
Varying stock sizes, number of hearths and hearth areas.
Hearths placed one above the other vertically, all enclosed in suitable shell. Vertical shaft revolves in center, raking ore on hearths, by rabbles and teeth attached to arms Ore travels through furnace from top to bottom. To correct inequalities in the supply of heat, combustion gases pass through heating chambers between hearths, as well as to hearths themselves. External fireboxes communicate with the heating chambers through flues. Central shaft designed to be accessible.

Furnaces, Smelting
Colorado Iron Works Co., Denver, Colo.

Repair Porous Castings with SMOOTH-ON Iron Cement No. 3

Just What You Need in The Mine

Pumps, engines, air drills or anything made of metal that leaks in the joints or because of porous metal can be permanently repaired with Smooth-On Iron Cement No. 3.

Repairs can be made in a very few minutes and in most cases without shutting down the equipment.

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Every one of the hundreds of uses for Smooth-On is explained in Smooth-On Instruction Book No. 15. Write for your free copy today.

Smooth-On Mfg. Co.
Jersey City N. J., U. S. A.

Innovations — are usually viewed with doubt, though the LUNKENHEIMER "CLIP" GATE VALVE

by more than twenty years of satisfactory service and a constantly increasing demand, proves its practicability.

The differences from the ordinary type of Gate Valve still remain innovations, and the successful service has proven the merits we claim for them.

The steel "clip" which secures the hub to the body, adds strength and rigidity to the valve and facilitates taking apart for cleaning or repairs.

Has but few internal movable parts, viz.: stem and single, sharp-tapered, double-faced disc.

Indestructible joint between body and hub.

Made with Iron Body in sizes as small as ¼-inch and has bronze inserted seats.

For handling cyanides and other acids which attack bronze, it is furnished in "all iron."

Material and workmanship of "Lunkenheimer Quality." Try them—you'll **adopt** them.

THE LUNKENHEIMER CO.
—"QUALITY"—

Largest Manufacturers of High Grade Engineering Specialties in the World

CINCINNATI

New York Chicago Boston London

Awarded *Medal of Honor* Panama-Pacific International 5-5-20 Exposition and *Grand Prize* Panama-California Exposition.

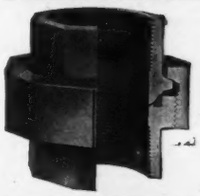
ALBANY GREASE

Reduces the cost of general mine lubrication without affecting efficiency of your compressor, fans, hoists, winding machine, engines, etc. You can try a quantity of Albany Grease and an Albany Cup at our expense. Write now.

ALBANY LUBRICATING CO., New York

JEFFERSON

For ALL Mine Purposes



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JEFFERSON UNION

to meet your conditions satisfactorily. Find out about the special Iron-to-Iron Ball Joint Jefferson Unions for cyanide plant pipe lines.

At your jobbers or write us direct.

The Jefferson Union Co., Lexington, Mass.

UNIONS

Automatic Improved **DRYERS** For All Materials

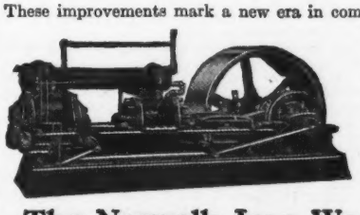
Economical Efficient Great Capacity American Process Co 68 William St NEW YORK

Automatic Selective Proportional Unloaders

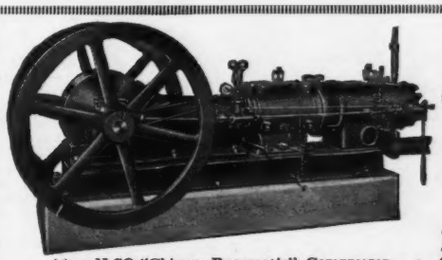
are found exclusively on the

Norwalk Compressor

These improvements mark a new era in compressor construction. They gain the instant and favorable attention of all skilled engineers. For the usual hackneyed claims of *economy*, *durability* and *efficiency*, let our forty years' experience be an assurance of adequate and discerning attention to every feature.



The Norwalk Iron Works Company
South Norwalk Connecticut



Class N-SO "Chicago Pneumatic" Compressor. Stationary or Portable.

Fuel Oil Driven Compressors combining the superior merits of our "GIANT" ENGINE and "CHICAGO PNEUMATIC" COMPRESSOR

"Chicago Pneumatic" compressors are built in over 300 sizes and styles for operation by steam, belt, short belt with idler, gasoline or fuel oil engine, or direct motor drive in capacities up to 5,000 feet of free air per minute. **Ask for Compressor Bulletins.**

CHICAGO PNEUMATIC TOOL CO.

1036 Fisher Bldg. Chicago **Branches Everywhere** **52 Vanderbilt Ave. New York**

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Traylor Eng. & Mfg. Co., Allentown, Penn.

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Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Gaskets
Johns-Manville Co., H. W., New York.

Gas Producers
Wellman-Seaver-Morgan Co., Cleveland, Ohio.
Wood & Co., R. D., Philadelphia, Penn.

Gas Purifiers
Wood & Co., R. D., Philadelphia, Penn.

Gears
Philadelphia Gear Works, 1120 Vine St., Philadelphia. Cable Address: "Philagear."
All sizes.
All descriptions gear cutting and wheels.

Gears, Bevel
Philadelphia Gear Works, 1120 Vine St., Philadelphia. Cable Address: "Philagear."
Webster Mfg. Co., Tiffin, Ohio.

Gears, Double Helical
Caldwell & Sons Co., H. W., 17th St. and Webster Ave., Chicago.
Falk Co., The, Milwaukee, Wis.
Any face to 42"; diameter to 12 ft.
Staggered herringbone teeth with continuous tooth engagement. Machine-cut from solid blanks.

Gears, Rawhide
Philadelphia Gear Works, 1120 Vine St., Philadelphia. Cable Address: "Philagear."

Generators, Electric
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Gloves, Asbestos
Johns-Manville Co., H. W., New York.

Graphite
Dixon Crucible Co., Joseph, Jersey City, N. J.

Grease
Albany Lubricating Co., 708 Washington St., New York. Cable Address: "Oezric."
Tallow lubricating compound in seven consistencies.
Agents in all principal cities.
Dixon Crucible Co., Joseph, Jersey City, N. J.

Grease Cups
Lunkenheimer Co., The, Cincinnati, O., U. S. A.

Grinders, Ore
Braun Corporation, The, Los Angeles, Calif.
Braun-Knecht-Heimann Co., San Francisco, Cal.
Laboratory machines for ore, coke and coal.
Sturtevant Mill Co., Boston, Mass.

Grinders, Sample
Denver Engineering Works Co., Denver, Colo.
Sturtevant Mill Co., Boston, Mass.

Head Frames, Mine
American Bridge Co., 30 Church St., New York.

Hoists, Electric
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Denver Engineering Works Co., Denver, Colo.
Flory Mfg. Co., S., Bangor, Penn.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Nordberg Mfg. Co., Milwaukee, Wis.
Ottumwa Iron Works, Ottumwa, Iowa.
Vulcan Iron Works, Wilkes-Barre, Penn.
Wellman-Seaver-Morgan Co., The, Cleveland, O.
Branches: New York and Denver, Colo.
Any size or capacity. Designed for any job. First or second motion.

Hoists, Portable
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Ingersoll-Rand Co., 11 Broadway, New York.
"Little Tugger"—for drill column, bar or timber mounting.

Hoists, Steam
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Flory Mfg. Co., S., Bangor, Penn.
Nordberg Mfg. Co., Milwaukee, Wis.
Ottumwa Iron Works, Ottumwa, Iowa.
Sullivan Machinery Co., Chicago, Ill., U. S. A.
First motion Corliss and geared slide valve with automatic cut-off.
Vulcan Iron Works, Wilkes-Barre, Penn.
Wellman-Seaver-Morgan Co., The, Cleveland, O.

Hose, Air
Cleveland Rock Drill Co., Cleveland, Ohio.
All sizes.
Plain and wire wound in stock.
Goodrich Co., The B. F., Akron, Ohio.
Sizes ½-in. up.
Constructed with canvas on outside for protection against cuts. Three grades.
Hardsocg Wonder Drill Co., Ottumwa, Iowa.
½", ¾", 1", plain and armored. Fitted with nipples and patent coupler.

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Hose, Rubber
Johns-Manville Co., H. W., New York.

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American Bridge Co., 30 Church St., New York.

Hydraulic Accumulators
Wood & Co., R. D., Philadelphia, Penn.

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Ainsworth & Sons, Wm., Denver, Colo.
Bausch & Lomb Optical Co., Rochester, N. Y.
Branches: New York, Washington, Chicago, San Francisco.
Transits and levels.
Berger & Sons, C. L., Boston, Mass.
Buff & Buff Mfg. Co., Boston, Mass.
Transits, levels, current meters.
Gurley, W. & L. E., Troy, N. Y. Branch: Maritime Bldg., Seattle, Wash.

Insulating Materials, Electric
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Jackets, Water
Traylor Eng. & Mfg. Co., Allentown, Penn.

Jigs
Denver Engineering Works Co., Denver, Colo.
Richards pulsator jigs and riffles.

Laboratory Machinery
Braun Corporation, The, Los Angeles, Calif.
Braun-Knecht-Heimann Co., San Francisco, Cal.
Denver Fire Clay Co., Denver, Colo.
Elmer & Amend, 205-211 Third Ave., New York.
Sturtevant Mill Co., Boston, Mass.

Lamps, Acetylene
Milburn Co., The Alexander, Baltimore, Md.
Simmons Co., John, 110 Center St., New York.
From 3- to 12-hr. capacity.
Baldwin and Zar. Cap and hand styles.
Wolf Safety Lamp Co., 74 Washington St., N. Y.

Lamps, Electric
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Lightning Arresters
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Line Material, Overhead
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Locomotives, Compressed Air
Porter Co., H. K., 410 Wood St., Pittsburgh, Pa.

Locomotives, Electric
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Locomotives, Electric, Storage Battery
Atlas Car & Mfg. Co., Cleveland, Ohio.
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Locomotives, Gasoline
Vulcan Iron Works, Wilkes-Barre, Penn.
Whitcomb Co., Geo. D., Rochelle, Ill.

Locomotives, Steam
Porter Co., H. K., 410 Wood St., Pittsburgh, Pa.
Branch: 30 Church St., New York.
Vulcan Iron Works, Wilkes-Barre, Penn.

Lubricants
Dixon Crucible Co., Joseph, Jersey City, N. J.

Lubricators
Whitcomb Co., Geo. D., Rochelle, Ill.

Mats and Matting
Johns-Manville Co., H. W., New York.

Metals, Noncorrosive
International Nickel Co., The, 43 Exchange Place, New York.
"Monel" metal. Tough acid-resisting alloy. Rods, flats, castings, sheets, strips and wire.

Metals, Perforated
Erdle Perforating Co., Rochester, N. Y.
Harrington & King Perforating Co., The, 620 N. Union Ave., Chicago, Ill. Branch: 114 Liberty St., New York.
All sizes and shapes of perforations; all kinds and thicknesses of metals.
Screens for trommels, stamp mills, jigs, etc.
Hendrick Mfg. Co., Carbondale, Penn.

Meters, Electric Current
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Mills, Ball and Pebble
Colorado Iron Works Co., Denver, Colo.
Denver Engineering Works Co., Denver, Colo.
Hardinge Conical Mill Co., 50 Church St., New York. Cable Address: Hailharding, N. Y.
Branches: London, Salisbury House; Denver, W. G. Swart, Consulting Engineer.
Sizes made, 3', 4½', 6', 8', 10'. Both ball and pebble mills. Capacities, 10 tons per day up to 800 tons per day.
Slow speed revolving mills for intermediate and fine grinding, employing a multitude of grinding media, either balls or pebbles, embodying the Hardinge Patent Conical principle, the cones acting as a classifier both of energy expended and material produced, to give a uniform product, due to this classifying action without the use of screens, grizzlies, grates or other mechanical attachments.
Agents: Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo., Sales Agents for Colorado, Wyoming, South Dakota and Montana.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Traylor Eng. & Mfg Co., Allentown, Penn.
Williamson, F. O., Old Colony Bldg., Chicago, Ill.

Mills, Chilean
Lane Mill & Machinery Co., Los Angeles, Calif.
Cable: "Lanemill."
Sizes: 5-, 7- and 10-ft. Capacities: 10, 20 and 40 tons per 24 hr.
"Slow-speed" Chilean mills. 20- and 40-ton mills can be sectionalized for transportation on pack animals.
Wellman-Seaver-Morgan Co., The, Cleveland, O.
"Akron." Three sizes from 10 to 160 tons per 24 hr.

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Allis-Chalmers Mfg. Co., Milwaukee, Wis.
All sizes and capacities.
Complete equipment.
Denver Engineering Works Co., Denver, Colo.
Hendrie & Bolthoff M. & S. Co., Denver, Colo.
Traylor Eng. & Mfg. Co., Allentown, Penn.

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Colorado Iron Works Co., Denver, Colo.
Denver Engineering Works Co., Denver, Colo.
Traylor Eng. & Mfg. Co., Allentown, Penn.
All sizes and capacities.

Minerals and Ores, Rare
Foote Mineral Co., 107 N. 19th St., Phila., Pa.
Specialists in unusual ores.

Mixers, Concrete
Smith Co., The T. L., 1143 32nd St., Milwaukee.
Hand batch mixer for mines, $120. Power mixers, all sizes, any equipment.

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Primos Chemical Co., Primos, Del. Co., Pa. Cable: "Briquette, Phila." Branches: Vanadium, Lakewood and Empire, Colo.; Dragoon, Ariz.
Agents: Allen S. Davison & Co., Pittsburgh, Pa.

Motor Control
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.
For all types and capacities of motors.

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Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

Motors
Westinghouse El. & Mfg. Co., E. Pittsburgh, Pa.

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Ludlow-Saylor Wire Co., St. Louis, Mo.
"Hex" poultry netting. Stack netting for locomotives.
Catalog No. 45.
Roebling's Sons Co., John A., Trenton, N. J.

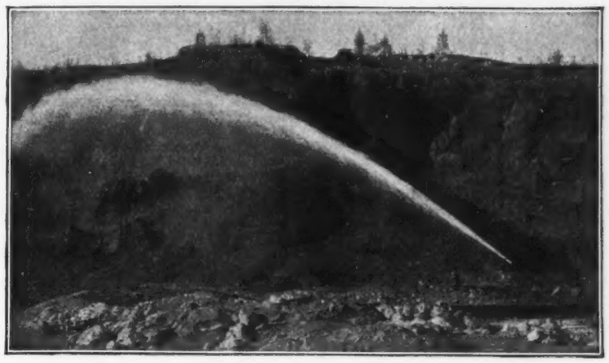
Nickel
International Nickel Co., The, 43 Exchange Place, New York.

Oiled Clothing
Goodrich Co., The B. F., Akron, Ohio.
So'westers, jackets, apron pants. Rubber goods for abrasive wear.

Oils, Flotation (See "Flotation Oils")

Ore Analyses
Tibby, Benj. F., 419 Judge Bldg., Salt Lake City, Utah.

Ore, Buyers and Sellers of
American Metal Co., New York City.
Agents: Henry R. Merton & Co., Ltd., London; Metallgesellschaft, Frankfort-on-the-Main; Compania des Minerales y Metales, Mexico City and Monterey; Ore Trading Co., Ltd., Santiago, Chile.
American Smelting & Refining Co., 120 Broadway, New York.
Agents: Paul Koning, Berlin, Germany; Kleinwort, Sons & Co., London, England; W. A. Price and Geo. J. Ewart, City of Mexico; F. D. Aller, Antofasgasta, Chile.
American Zinc, Lead & Smelting Co., 55 Congress St., Boston, Mass.
American Zinc & Chemical Co., Langeloth, Penn.
Balbach Smelting & Refining Co., Newark, N. J.
Bartlesville Zinc Co., 52 Broadway, New York.
Beer, Sondheimer & Co., 61 Broadway, New York. Branch: 1101 Newhouse Bldg., Salt Lake City, Utah.
See advertisement.
Blackwell, Sons & Co., Ltd., Geo. G., The Albany, Liverpool, England.
Consolidated Mining & Smelting Co. of Canada, Ltd., The, Trail, British Columbia.
Ducktown Sulphur, Copper & Iron Co., Ltd., Isabella, Tenn.
Edgar Zinc Co., Boatmen's Bank Bldg., St. Louis, Mo. Western Ore Purchasing Agent: David Taylor, Boston Bldg., Salt Lake City, Utah.



Hydraulic Mining—Yukon Gold Co.

Water supplied through TAYLOR SPIRAL RIVETED PIPE

New York, Jan, 16, 1911.

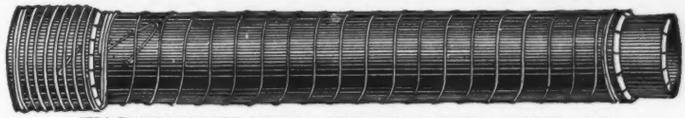
"Gentlemen: We beg to acknowledge yours of Jan. 9th, making inquiry as to our experience with your Spiral Riveted Pipe.

Our first use of Spiral Riveted Pipe was in connection with our hydraulic mining operations as distributing lines from our main ditch system. The pipe was given severe service and proved entirely satisfactory. We are now using it in diameters up to 42 inches and heads up to 530 feet. We have found the pipe easy to lay and handle, strong for its weight and generally satisfactory.

Very truly yours,
(Signed) Yukon Gold Co.
O. B. Perry, Gen. Mgr."

Catalog and Special Prices on request.

AMERICAN SPIRAL PIPE WORKS, Chicago, Ill.



WASHINGTON PIPE AND FOUNDRY COMPANY
1512 to 1620 Asotin St., 3001 to 3019 Jefferson St.,
Tacoma, Wash., U. S. A.

We Can Supply Pipe For Any Purpose You May Require

Our plant is a large one.

Our prices are *right*. Our goods give highest satisfaction for longest period. It costs you nothing to consult with us. Write us of your needs, *today*.

WOOD PIPE — NATIONAL QUALITY — OIL AND WATER TANKS

Get our figures and delivered prices on NATIONAL tanks for all purposes. We ship you direct. Address Dept. B.

Not subject to corrosion, Douglas Fir is the best material possible, and being light, cost of shipment is low.

NATIONAL TANK & PIPE CO. 275 OAK ST. PORTLAND, ORE.

NATIONAL TUBE COMPANY

PITTSBURGH
PA.

The Accumulated Skill and Experience of 25 Years

in selecting and seasoning Redwood and Douglas Fir and in manufacturing **wood tanks** and **continous stave and machine banded wood pipe,** goes into both Pacific Tanks and Pipes. The result—added value to you. May we not go into full details? Write.

Pacific Tank & Pipe Company

ESTABLISHED 1890

General Office: 5th and Bryant Sts.
San Francisco, Cal.
Branch Office: Los Angeles, Cal.

Good-Bye Rust

Make your pipes everlasting. Do not allow corrosion to set in. Protect them from it with

Highland Non-Corrosive Coating

Made in **three grades** for the protection of all kinds of steel. Thoroughly prevents all forms of corrosion. **Let us mail you our interesting descriptive booklet. Yours for the asking.**

HIGHLAND
CHEMICAL PRODUCTS CO.
CONNELLSVILLE, PA.

PENN BRIDGE CO.

BEAVER FALLS, PA.

Contractors and Manufacturers of Structural Steelwork for

BRIDGES,
of All Kinds, Including Suspension and Bascule Types.

BUILDINGS,
for all Purposes, Requiring Fabricated Steelwork.

TANKS, for Water, Oil, and Cyanide | **TOWERS,** Water, Transmission, Radio, Standpipes | **BINS,** Ore, Coal, Coal Pockets

LOCK GATES AND DAMS.

Granby Mining & Smelting Co., Suite 1710, Third National Bank Bldg., St. Louis, Mo.
Agent: Robert W. Conklin, 165 Broadway, New York, N. Y.
Hegeler Zinc Co., The, Danville, Ill.
Illinois Zinc Co., Peru, Ill.
International Smelting Co., 42 Broadway, New York. Ore Purchasing Department, 621 Kearns Bldg., Salt Lake City, Utah. Smelting Works, International, Utah, and Miami, Ariz. Refineries, Raritan Copper Works, Perth Amboy, N. J.; International Lead Refining Co., E. Chicago, Ind. Irvington Smelting & Refining Works, Irvington, N. J. Branch Office: New York.
Matthiesson & Hegeler Zinc Co., La Salle, Ill.
Nichols Copper Co., 25 Broad St., New York.
See advertisement.
Pass & Son, Ltd., Capper, Bristol, England.
Pennsylvania Smelting Co., Pittsburgh, Penn.
Phelps, Dodge & Co., New York City.
Philipp Bros., 42 Broadway, New York.
Primos Chemical Co., Primos, Del. Co., Pa. Cable: "Briquette, Phila." Branches: Vanadium, Lakewood and Empire, Colo.; Dragoon, Ariz. Agents: Allen S. Davison & Co., Pittsburgh.
St. Joseph Lead Co., 61 Broadway, New York.
United Metals Selling Co., 42 Broadway, New York. European Agents: C. S. Henry & Co., Ltd., 12 Leadenhall St., London, E. C.; United Metals Selling Co., G. M. B. H., Unter den Linden 56, Berlin, Germany.
See advertisement.
United States Smelting, Refining & Mining Co., 55 Congress St., Boston, U. S. A. Works: Midvale, Utah; Naadles, Calif.; Gold Road, Ariz.; Kennett, Calif.; Chrome, N. J.; Grasselli, Ind.; Pachuca and Real del Monte, Mexico.
See advertisement.
Vogelstein & Co., L., 42 Broadway, New York.
European Agents: Aron Hirsch & Sohn, Halberstadt, Germany.

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Mississippi River Power Co., Keokuk, Iowa.
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Highland Chemical Products Co., Connellsville, Penn.

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Shriver & Co., T., 826 Hamilton St., Harrison, N. J.
Sweetland Filter Press Co., Singer Bldg., N. Y.
Worthington, Henry R., 115 Broadway, New York.

Presses, Hydraulic
Wood & Co., R. D., Philadelphia, Penn.

Publishers, Technical Book
McGraw-Hill Book Co., Inc., 239 W. 39th St., New York. Branches: London and Berlin.

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Braun Corporation, The, Los Angeles, Calif.
Laboratory machines for all purposes and prospecting.
Braun-Knecht-Heimann Co., San Francisco, Cal.
Sturtevant Mill Co., Boston, Mass.

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Wood & Co., R. D., Philadelphia, Penn.

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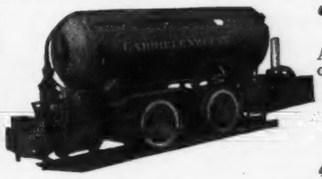

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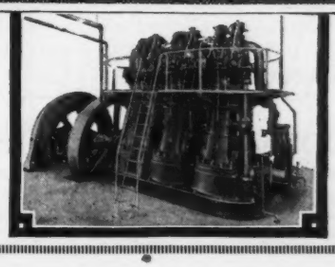

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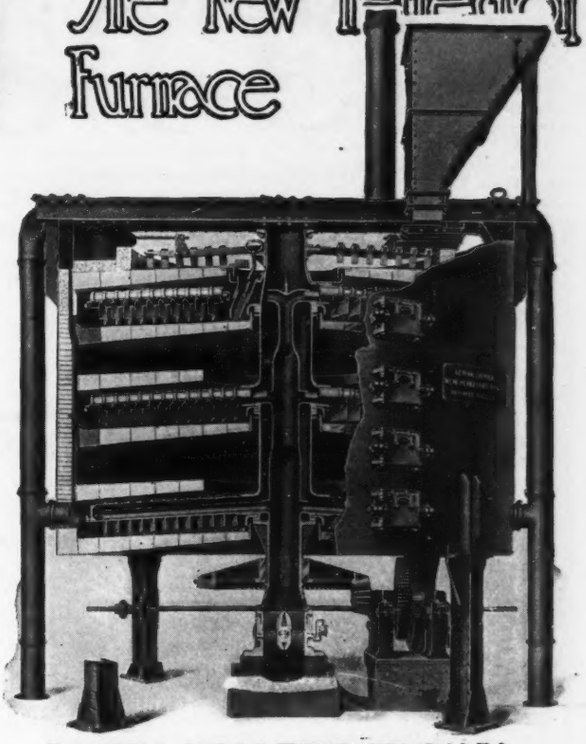

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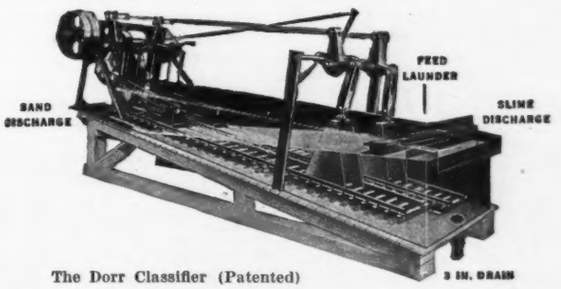

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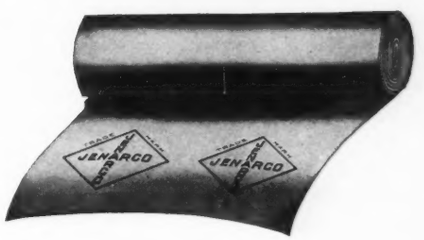

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